JOURNAL

OF

THE FRANKLIN INSTITUTE

OF THE STATE OF PENNSYLVANIA

FOR THE

PROMOTION OF THE MECHANIC ARTS.

DECEMBER, 1852.

CIVIL ENGINEERING.

On the Expansion of Isolated Steam, and the Total Heat of Steam. By Mr. CHARLES W. SIEMENS.*

The object of this paper is to lay before the members the results of certain experiments on steam, purporting, in the first place, to corroborate Regnault's disproval of Watt's law—"that the sum of latent and sensible heat in steam of various pressures is the same;" in the second place, to prove the rate of expansion by heat of isolated steam; and, in the third place, to illustrate the immediate practical results of those experiments in working steam engines expansively.

The amount of heat required to convert one pound of water into steam of different pressures, has occupied the attention of natural philosophers from the earliest periods of the modern steam engine. Dr. Black observed, about a century ago, that a large quantity of heat was absorbed by water in its conversion into steam, (not accompanied by an increase of temperature,) which he termed "the latent heat of steam." His apparatus consisted simply of a metallic vessel containing water, which he exposed to a very regular fire; and from the comparative time which was occupied, first in raising the temperature of the water to the boiling point, and, secondly, in effecting the evaporation, he approximately determined the amount of latent heat. Resuming the experiment, in conjunction with Dr. Irvine, he employed a different apparatus, consisting of a steam generator, and of a surface condenser, or a serpentine tube, surrounded by a large body of cold water. The steam which condensed in the serpentine tube was carefully collected and weighed, and the rise

* From the London Journal of Arts and Sciences, September, 1852.

of temperature of the surrounding water was observed, which, multiplied by its known quantity, represented the total quantity of heat which the steam had yielded.

The quantity of heat requisite to raise the temperature of one pound of water through 1° Fahr., being taken for the unit of heat, Black and Irvine obtained for the total quantity of heat in

Steam of atmospheric pressure, the number,	954
Southern,	1021
Watt,	1140
Regnault,	1145
Dr. Ure,	1147
Desprer, 1136, but later,	1152
Brix,	1152
Guy Lussac and Clement,	1170
Count Rumford,	1206

All of these eminent experimentalists employed essentially the same apparatus, and the differences between their results prove its great liability to error. Brix, of Berlin, was the first to investigate those errors, and to calculate approximately their effect upon the results obtained.

While such a large amount of labor and talent has been expended, to determine the latent heat in steam of atmospheric pressure, a far more important question seems to have been passed over with neglect, namely, What is the relative amount of heat in steam of various densities? Watt justly perceived the importance of this question, but contented himself with one experiment, upon which he based his law, "that the sum of latent and sensible heat in steam is the same under all pressures." Southern repeated the experiment, and found that steam of greater density contained absolutely more heat than steam of lower pressure, which induced him to adopt the hypothesis, that "the latent heat of steam was the same at all pressures."

Subsequent experiments and general reasoning seemed to be in favor of Watt's law, which enjoyed general confidence until it was attacked, only a few years since, by Regnault, of Paris, who proved, by a series of exceedingly elaborate and carefully conducted experiments, that neither the law of Watt nor that of Southern was correct, but that the truth lay between the two. The apparatus employed by M. Regnault may be said to be a refinement upon those previously employed, and with the advantage of Brix's labors, to determine the amount of errors, he seems to have succeeded in measuring the absolute amount of heat in steam of various pressures with surprising accuracy. The costly and complicated nature of the apparatus employed by M. Regnault, has hitherto prevented other experimentalists from repeating the experiment; and, in the mean time, practical engineers still continue to adhere to Watt's law.

Shortly after the publication of Regnault's experiments by the Cavendish Society, in 1848, the idea occurred to the author of the present paper that their results might be brought to a positive test by a simple apparatus, which he exhibited to the meeting in operation. It consists of an upright cylindrical vessel of tin-plate, surrounded by an outer vessel, filled with charcoal, or other non-conducting material. A steam pipe, with a contracted glass vein or nozzle, enters the upper part of the inner vessel, in a position inclining upwards, in order that the water of priming

from the boiler, and of condensation within the pipe, may return to the former, allowing only a small jet of pure steam to enter the vessel, where it suddenly expands, and communicates its temperature to the bulb of a thermometer, which is inserted through a stuffing box from above. The lower extremity of the inner vessel is connected on the one hand to a mercury gauge, and on the other to a condenser, by means of a stop cock to regulate the pressure. The pressure and temperature of the steam within the boiler being known, and the temperature of the expanded steam observed, it will be seen whether that temperature coincides with the temperature which is due to pressure indicated by the mercury gauge. If it did, then Watt's law would be confirmed; but since the temperature rises higher than is due to the pressure, it follows that the high pressure steam contains an excess of heat, which serves to *super-heat* the expanded steam. All losses of heat from the apparatus would tend to reduce the temperature, and be in favor of Watt's law; but it will be shewn that those losses may be entirely eliminated, and a true quantitative result be obtained. For this purpose, the pressure in the boiler should first be raised to its highest point, and the indicating apparatus be well penetrated by the heat: the fire under the boiler should thereupon be reduced, and observations made simultaneously, and at regular intervals, of the declining pressure within the boiler, and temperature of the expanded steam of constant pressure. The pressures being nearly equal, the fire under the boiler is again increased, and the observations continued until the maximum pressure is once more obtained; and the loss of heat by radiation, &c., may be correctly estimated, by a comparison of the two series of observations.

The second portion of this paper relates to the rate of expansion of isolated steam by heat, that is, steam isolated from the water from which it is generated.

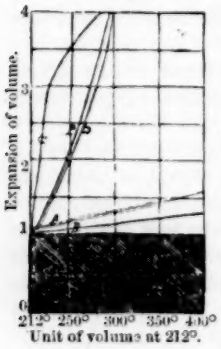
The author has not been able to meet with any direct experiments on this subject, except some at a recent period by Mr. Frost, of America, which, however, do not seem entitled to much confidence. The rate of expansion of air and other permanent gases by heat was first ascertained by Dalton and Guy Lussac simultaneously, who determined that all gases expanded uniformly, and at the same absolute rate, amounting to an increase of bulk equal to $\frac{1}{480}$th part of the total bulk at 32° Fahr. for every degree Fahr., or $\frac{1}{848}$th part of the total bulk at 212°. Dulong and Petit confirmed the law of Dalton and Guy Lussac; but it appears that these philosophers confined their labors to the permanent gases and atmospheric pressure, and merely supposed the general applicability of their discovery.

Being interested in the application of "super-heated" steam, the author tried some direct experiments on its rate of expansion, in the year 1847, which confirmed his view, that vapors expand more rapidly than permanent gases; or, in other words, that the rate of expansion of different gases and vapors is equal, not at the same absolute temperature, but at points equally removed from their point of generation.

The apparatus employed in these experiments consists of a metallic trough, containing oil, which is placed upon a furnace, heated by the flame of gas. One end of the trough is provided with a stuffing box,

through which a glass tube, of about $\frac{1}{16}$th inch diameter, and sealed at one end, may be slipped, and will rest horizontally upon a scale below the surface of the oil. The mouth of the glass tube is connected to an open mercury syphon, with either the one or the other leg filled with mercury, to produce the desired pressure within the horizontal glass tube. A small drop of water and a piston of mercury being introduced into the bottom of the tube, it is placed in the oil bath, and connected to the syphon. The oil bath is then gradually heated, and the temperature observed. As soon as the boiling point of water under the pressure in question is reached, the mercury piston will move rapidly forward, until all the water is converted into steam. The temperature continuing to increase, the piston will continue its course more slowly upon the scale, where its progress is noted from time to time, together with the temperature. The experiment is continued until the temperature reaches about 400°, when the oil begins to boil: the gas flame is then withdrawn, and the bath allowed to cool gradually. The observations of the temperature and the position of the mercury piston are continued until the steam contained behind it is recondensed. A comparison between the two series of observations gives the correct mean of the experiment, by which the effects of the friction of the mercury piston, any possible slight leakage of steam past it, and faults consequent on the slow transmission of heat, are completely neutralized.

The curve, A, on the diagram, has been drawn, expressing the rate of expansion of atmospheric steam according to these experiments. The results of nine separate experiments very nearly coincide (as shown by the dotted lines, which give the extreme variation in the experiments), except at the starting point, where the rate of expansion is so very great, that it is difficult to obtain correct observations: changes in the barometer, moreover, affect the curve in the vicinity of the boiling point. To obviate the effect of these inaccuracies, the unit of volume in laying down the curves from each of the nine experiments was taken, not at the absolute boiling point, but at 250°, where the expansion had already assumed a definite course.



The diagram also shows a straight line, B, expressing the rate of expansion of common air, which at first diverges greatly from the hyperbolic curve of expansion of steam, although the asymptote of the latter seems to run parallel to the former. The author considers it, therefore, highly probable, "that the rate of expansion of all gases may be expressed by one hyperbola, which starts from the condensing point of the gas," and that the apparently uniform rate of expansion of the permanent gases may be accounted for by their great elevation, at the ordinary temperature, above their supposed boiling point, in consequence whereof the true curve approaches so nearly to its asymptote that the difference cannot be detected by experiments.

The general result obtained from the above experiments may be stated

as follows:—That steam generated at 212°, and maintained at a constant pressure of one atmosphere, when heated out of contact with water to

230°	is expanded	5	times more than air would be.	
240°	ditto	4	ditto	ditto.
260°	ditto	3	ditto	ditto.
370°	ditto	2	ditto	ditto.

The author intends to extend the range of his experiments upon gases and vapors under high pressure, and will communicate the further results to the Institution.

The diagram contains another curve, C, showing the results of Mr. Frost's experiments (alluded to before,) which, from the very sudden and irregular rise at the commencement, appears to be affected by some serious source of error.

The two curves of pressure and density, P, and D, show the rate at which saturated steam increases in pressure and in density with the rise of temperature marked at the bottom of the diagram. It will be observed that the pressure increases at a rather greater rate than the density; and it is a remarkable circumstance, that the difference, or the rate at which the pressure increases faster than the density (which is in effect the rate of expansion of saturated steam with the increase of sensible temperature), exactly coincide with the line, B, representing the rate of expansion of atmospheric air.

It has been theoretically demonstrated that a perfect Boulton and Watt condensing engine (abstracting friction and all losses of heat in the furnace and through radiation) would only yield about 7 per cent. of the mechanical force, which would be equivalent to the expanded heat. It may be argued from this, that the steam engine is destined to undergo another great modification in principle; and, in the author's humble opinion, this crisis will be accelerated by inquiries into those properties of gaseous fluids which have hitherto excited but little attention, and especially into the properties of dry steam, or isolated steam.

The present paper will be confined to shewing the effect of the above experiments upon the rate of expansion of steam within the steam cylinder of an engine. It was demonstrated by the first named experiments, that expanded steam is super-heated steam; and, by the second, it is shown what is the expansion of bulk due to an increase of temperature. Supposing the results of the experiments to be correct, the expansion curve as laid down by Pambour, and which is based upon Watt's law, requires a modification due to the excess of temperature in expanding steam, and it will be observed, that this correction in the curve of expansion is in favor of working engines expansively; as a greater average pressure is obtained during expansion than would be the case if the expanded steam were not thus super-heated. Its correctness is corroborated by some actual observations by Mr. Edward A. Cowper in taking diagrams of expansive engines, previous to his acquaintance with the above experiments. It moreover appears, that in Cornwall engineers have been practically acquainted with the fact, that expanded steam is super-heated steam, and more economic in its use than saturated steam; for it is a practice with them to generate the steam at very high pressure, and to expand it down

to the required pressure previous to its reaching the steam cylinder. Another remarkable practical observation is, that a jet of high pressure steam does not scald the naked hand, while a jet of low pressure steam does, although the high pressure steam is the hotter substance. The cooling effect of a jet of high pressure steam is so powerful, that, as the author has been informed, ice has been actually produced in the heat of summer in America, by blowing a powerful jet of steam of 400 lbs. pressure per square inch against a damp cloth. This phenomenon may be explained by the perfectly dry and under saturated state of expanded steam, which with a strong tendency to re-saturate itself, produces a powerful evaporation on moist surfaces with which it comes in contact. The rapid rate of expansion of steam by heat, when still near its boiling point, proves the economy of heating the steam cylinder, either by a steam-jacket, or by the application of fire. It is, however, important to observe, that the specific heat of steam seems to diminish, the more the temperature exceeds the boiling point.

Mr. Crampton inquired whether the charcoal in the casing of the instrument would not get heated by the tube of high pressure steam passing through it during the experiment, and so super-heat the steam in the internal cylinder?

Mr. Siemens explained, that it was not possible for such an effect to take place, as the end of the steam pipe was exceedingly small, and was protected by a thick non-conducting casing. He had also observed several times during the experiments, that whenever any priming took place in the boiler, and a drop of water came out with the steam and fell on the bulb of the internal thermometer, the mercury fell immediately to 212°, or the boiling point of water, and remained steadily there for four or five minutes, until the whole of the priming water was converted into steam, when the mercury again gradually rose to its former temperature. This showed that the increased temperature above 212° in the internal cylinder was entirely due to the extra heat in the expanded high pressure steam, and not to any heat derived from the charcoal casing.

Mr. E. A. Cowper observed, that the only source of heat to raise the temperature of the charcoal casing, was the super-heat in the expanded steam in the interior of the cylinder; as the jet of high pressure steam was so small and well protected, that it could not have any appreciable effect in heating the charcoal: consequently, the charcoal casing could only attain the temperature of the expanded steam that was passing through it, and could not influence the temperature of that steam. In the first experiments tried by Mr. Siemens and himself, the lower end of the cylinder was entirely open to the atmosphere, so as to try the experiment with steam expanded down to the atmospheric pressure; and as the expanded steam was passing out into the atmosphere in a constant stream from the open mouth of the cylinder, it was impossible there that the increased temperature maintained in the cylinder could have been affected by the charcoal casing, and it could only have been due to the extra heat contained in the high pressure steam.

Mr. Siemens said, that as a check on the accuracy of the observations, he had tried them successively in an ascending and a descending series, when any error from the source alluded to would have been made appa-

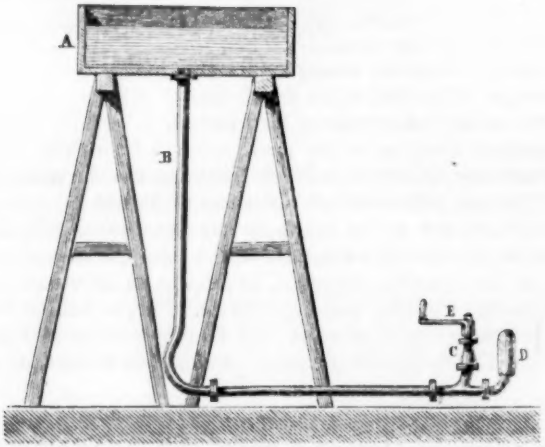
rent and been doubled in effect; but he could not detect more than one degree difference in the observations.—*Proc. Inst. Mech. Eng., Birmingham, England.*

---

*On the Use of Air Vessels in Pumps.**

Some experiments have been made by Messrs. Kirchweger and Prusman, engineers, of Hanover, on the positive effect produced upon the action of pumps by the application of air vessels on the suction pipes. Air vessels have been applied for many years on delivery pipes, but it is only lately that their value has been properly estimated, although it is obvious that it is of as much importance that the pump should be filled with water, as that the delivery should be constant.

Fig. 1.



The apparatus employed by the German engineers is represented in section in fig. 1. A is a reservoir, which represents the source whence the pump draws its water, B is the suction pipe, and C is a valve-chest, containing a ball valve, surmounted by a cock discharging at the side. The plug of the cock is stationary, whilst the shell is moved by the handle, E. D is the air vessel.

Fig. 2.

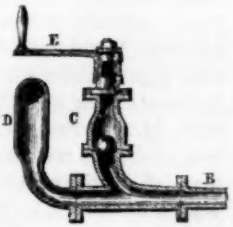


Fig. 2 shows the details of the valve on a larger scale.

It is obvious that, by causing the cock to revolve by means of the handle, E, a certain volume of water will escape each time the passage is opened, the height of water column in the pipe, E, answering to the pressure of the atmosphere in causing the water to fill the pump.

The result of the trials was that, when the air vessel was removed, and the opening stopped, an increased velocity of rotation of the cock gave less water; but with the air vessel the increase of velocity gave more water.

* From the London Artizan, October, 1852.

The trials were made with different speeds and different pressures of water, with the results shown in the following table:—

Nnmber of turns per minute.	Gallons of water delivered per minute, under a mean pressure of			
	17 feet.	12½ feet.	8½ feet.	2¾ feet.
With air vessel.				
80	12·9	12·78	8·79	2·83
100	15·6	15·43	11·25	4·82
120	17·15	16·63	12·23	5·44
140	18·28	16·75	12·98	5·54
Without air vessel				
80	9·45	8·62	6·902	2·36
100	8·03	8·08	6·05	1·98
120	6·55	6·54	5·42	1·88
140	5·42	6·29	5·17	1·51

The capacity of the air vessel is 66 cubic inches.

The weight of the ball valve 2·315 lbs.

The area of the valve seat = 11·5 inches.

The smallest diameter of the feed pipe is 1·48 inches.

The quantities delivered at 80 to 100 turns are the mean of four trials; those of 120 and 140 turns are the mean of 3 only.

If these trials are to be taken as the exact result which may be expected under similar circumstances with a pump, it is evident that a large increase of duty may be expected, by adding an air vessel on the suction side of a pump, working at a high speed. For, it will be observed that, whilst at 80 turns the increase is only 20 per cent., at 100 turns it is 133 per cent., at 120 turns 189 per cent., and at 140 turns 266 per cent.

Notice on a Disputed Question connected with the Economy of the Steam Engine. By James Apjohn, M. D., Professor of Chemistry and Mineralogy, T. C. D., M. R. I. A.*

It has been frequently proposed to substitute the vapor of some volatile liquid, such as alcohol or ether, for that of water in the steam engine, under the idea that by so doing fuel would be economized; and the proposal appears *prima facie* plausible, seeing that their boiling points are not only lower than that of water, but that the same is true of their specific heats, and of the latent heats of their vapors. This idea would seem to have struck at different times the minds of different persons, and the Rev. Mr. Cartwright, a gentleman of great mechanical genius, and celebrated for his mechanical inventions, actually devised a most ingenious form of steam engine (see *Phil. Mag.*, vol. i, 1st ser.), in which the piston was to be moved by the vapor of alcohol. Mr. Ainger, in a notice brought by him before the Royal Institution, London, in February, 1830, on the economy of the steam engine, would seem to be the first person who publicly dissented from such views; and he has certainly the merit of having shown the insufficiency of the data generally used by those who, previous to his time, calculated that the substitution of more volatile liquids for water

* From the London Chemical Gazette, October, 1852.

would lead to a considerable saving of fuel. The conclusion, however, at which he arrives, that, leaving the original cost of the liquids out of consideration, water would be as economical a liquid as alcohol or ether, I believe to be quite erroneous; and as the question at issue is one of some practical importance, I shall proceed to state succinctly the method of calculation which I have employed in discussing it, and the precise results at which I have arrived.

As the vapors of different liquids have at their respective boiling points the same elastic force, equal volumes of them will produce equal mechanical effects. In order, therefore, to the solution of the question under consideration, it will only be necessary to calculate the weights of the different liquids, water included, which give equal volumes of vapors, and to determine the quantities of caloric necessary for the conversion of these into vapor.

Now, as the volume of a vapor, like that of any other form of matter, is represented by its weight or mass divided by its specific gravity, if we put

$$\frac{x}{s^1} = \frac{1}{s},$$

x being the weight of any vapor whose specific gravity is s^1, and s the specific gravity of the vapor of water, we shall get

$$x = \frac{s^1}{s},$$

that is, the weight of any liquid which at its boiling point gives a volume of vapor equal to that given by a weight of water represented by unity at *its* boiling point, is got by dividing the specific gravity of the vapor by that of steam.

But the specific gravities to be used in this computation are not those usually given in books, each of which is referred to a different unit, viz: air at the same temperature, and under the same pressure as the vapor; but the specific gravities of the vapors at the respective boiling points of the several liquids, compared to the standard unit, viz. air at 60°, and under a pressure of 30. In the following table, the former specific gravities are found in the second, and the others in the third column, the latter being in each case got by multiplying the former by $\frac{518}{458+t}$, t being the boiling point of the liquid which yields the vapor. In column 4 we have the weights which would give equal volumes of vapors, calculated by the expression $x = \frac{s^1}{s}$ already given, the values of s and s^1 being taken from column 3:—

1.	2. Specific gravity referred to air at boiling points.	3. Specific gravity at boiling points referred to air at 60°.	4. Weights giving equal volumes.
Water. . . .	0·622	0·480	1·000
Wood spirit, . .	1·120	0·950	1·979
Alcohol, . . .	1·613	1·322	2·754
Ether, . . .	2·586	2·397	4·993

It is now easy to assign the quantities of caloric necessary to produce an equal volume of the vapor of each liquid at their respective boiling points, for these will obviously be represented by the expression

$$mc\{(t-50)+l\},$$

m being for each liquid its number in column 4, c its specific heat, t its boiling point, and l the latent heat of its vapor at the temperature of ebullition. When, with the aid of the annexed table—

	Boiling points.	Specific heats.	Latent heats.
Water, . . .	212·0°	1·00°	961·8°
Wood spirit, . .	151·7	0·67	475·2
Alcohol, . .	172·4	0·64	374·4
Ether, . . .	100·4	0·50	163·8

which exhibits the specific and latent heats on which most reliance can be placed, the numerical calculation is made, the following are the results:

Water, ...	1129·0	1·000
Wood spirit, ...	764·8	0·676
Alcohol, ...	875·5	0·775
Ether, ...	534·7	0·473

The mere inspection of these numbers is sufficient to show that Mr. Ainger is in error, or that by substituting for water, wood spirit, alchol, or ether, the same moving force will be obtained, and with a great saving of fuel. With wood spirit about two-thirds, with alcohol about three-fourths, and with ether somewhat less than half the caloric required by water will suffice.

To the use, however, of such liquids there are obvious objections. Their cost is considerable compared to that of water; and as they evolve at atmospheric temperatures vapors of a considerable elastic force, they will, from imperfect condensation, resist the descent of the piston, and thus give rise to an appreciable loss of power. But notwithstanding this practical difficulty, which by the way is not, in the cases of alcohol and wood spirit, one of a very formidable nature, the theoretic conclusion is no less certain, that equal volumes of the vapors of different liquids, formed at their respective boiling points under the pressure of a single atmosphere, *do not* require for their production equal quantities of caloric.

AMERICAN PATENTS.

List of American Patents which issued from Oct 12th, to Nov. 2d, 1852, (inclusive,) with Exemplifications by Charles M. Keller, *late Chief Examiner of Patents in the U. S. Patent Office.*

20. For *Improved Apparatus for Heating Feed Water of Steam Boilers;* Matthias W. Baldwin, Philadelphia, and David Clark, Schuylkill Haven, Pennsylvania, October 12.

Claim.—"What we claim as our invention is, the arrangement of a heater for the feed water of steam boilers, with respect to the chimney, smoke box, and the blast pipes of the escape steam, substantially as herein described; so that the heated smoke and gases from the smoke box, and the exhaust steam from the cylinder, shall pass separately through the heater, in distinct tubes or channels, in such manner that they cannot mix until both have passed the heater, as herein set forth."

21. For an *Improvement in Mill Stones;* Thomas Barnett, Beverly, England, October 12; patented in England, January 8, 1852.

Claim.—"I am aware that holes or apertures in upper and under mill stones have been some time in use, and I do not claim simply the making of holes or apertures in mill stones as my invention; but I do claim the making in under mill stones, of holes or apertures, covered with wire gauze cloth, perforated metal plates, or any other substance that will allow part of the meal to pass through, after it is sufficiently ground, in combination with holes or apertures in upper mill stones, containing sweepers, brushes, or rubbers, for the purpose of sweeping, rubbing, or brushing the meal over or through the wire gauze cloth, perforated metal plates, or other substances, without confining myself to the exact detail described in the above specification."

22. For an *Improvement in Gang Ploughs;* Charles Bishop, Norwalk, Ohio, October 12.

Claim.—"Having fully described the nature of my invention, what I claim as new is, the manner herein described of constructing the mould boards, and combining them with the blade, in the manner substantially as herein specified."

23. For an *Improvement in Sugar Boiling Apparatus;* William H. Clement, Philadelphia, Pennsylvania, October 12.

Claim.—"What I claim as my invention is, 1st, The arrangement and combination of the simmering vessel with the ball cock and the scumming trough, substantially as described in the first part of the foregoing specification; and I claim this arrangement and combination, whether alone, or in further combination with a partial covering of the bottom of the simmering vessel, or the introduction of the steam worm, as there described.

"2d, The agitator, arranged and operating in the manner and for the purposes substantially as described in the second and fourth part of the foregoing specification."

24. For an *Improvement in Scumming Apparatus for Sugar Pans;* William H. Clement, Philadelphia, Pennsylvania, October 12; patented in England, July 23, 1846.

Claim.—"In conclusion, I wish it to be understood that I claim as my invention, 1st, the application in the manufacture of sugar, of rotating paddles or leaves, for skimming or taking off the scum and gummous matters from the surface of the liquor."

25. For an *Improvement in Distilling Apparatus;* Charles Delescluze, City of New York, October 12.

"The nature of my invention consists in apparatus for distilling and rectifying spirits, without interruption and without the use of charcoal. I can distil by means of my apparatus, as pure a spirit as that which is imported into this country from Montpelier, France."

Claim.—"What I claim as my invention is, 1st, The combination and arrangement of the boilers, *a* and *p*, connected by the pipes, *b* and *l*, with the column, *z*, which enables me to work continually and without interruption, by distilling the contents of one boiler, while the other boiler is being filled, and thus distilling the contents of one boiler immediately after the other, as seen in the description of the work in the former part of this specification.

"2d, The combination and arrangement of the worm, *v*, situated between the two boilers, *a* and *p*, and of the pipes, *u* and *x*, which connect the boilers, *a* and *p*, with the worm, *v*, enabling me to test and ascertain the nature of the liquid contained in the boiler under operation, and to ascertain when the contents of that boiler are distilled."

26. For an *Improvement in Illuminating Gas Apparatus;* Robert Foulis, St. Johns, New Brunswick, October 12.

Claim.—"What I claim as my invention is, 1st, the return pipe, in combination with the retort, substantially as set forth.

"2d, I claim, in combination with the said pipe, the false bottom and lining, as described.

"3d, I claim the arrangement of the decomposing chamber, in combination with the return pipe in the vertical retort.

"4th, I claim the employment of the series of decomposing trays under the arrangement in the vertical retort, substantially as described, in combination with the central pipe.

"5th, I claim refrigerating the gas by air, substantially in the manner described."

27. For an *Improvement in Modes of Making India Rubber Bat Cloth;* Charles Goodyear, New Haven, Connecticut, October 12.

Claim.—"What I claim as my invention is, passing the bat or fleece of cotton, flax, silk, or other fibrous substance, together with dissolved or softened caoutchouc, gutta percha, or other vulcanizable gum, or the compounds or preparations thereof, between calendering rollers, with an elastic substance interposed between the bat or fleece and one of the rollers, as described, or between the glazed apron and one of the rollers, substantially as described."

28. For an *Improvement in Electro-Magnetic Engines;* John S. Gustin, Trenton, New Jersey, October 12.

"The nature of my invention consists in so arranging the electro-magnets and the parts connected therewith, that their great power of attraction, in close proximity, is continued through the required length of stroke of a reciprocating engine of large or small size."

Claim.—"What I claim as my invention is, supporting the principal part of the weight of the armatures of the electro-magnets, mounted upon sliding guides or their equivalents, upon the reciprocating frame, as described, by means of springs or their equivalents, attached to said frame, so as to preserve the balance of weight in the moving parts, substantially as set forth."

29. For an *Improvement in Safety Valves;* Alfred Guthrie, Chicago, Illinois, October 12.

Claim.—"What I claim as my invention is, the construction of the cock in the connecting pipe, by which the resistance to the pressure is taken off, and at which the steam will be allowed to escape."

30. For an *Improvement in Double Seaming Machines;* Walter Hamilton, Elmira, New York, October 12.

Claim.—"Having fully described the construction and operation of my improved machine, what I claim is, the mandrel, with heads removable at pleasure, in combination with two or more pressure rollers, operating with the same, and with a mallet acting simultaneously with said mandrel and pressure rollers.

"I also claim the adjustable steadying rollers or their equivalents, arranged with reference to the mandrel, and acting substantially in the manner and for the purpose herein set forth."

31. For an *Improvement in Hominy Mills;* James Hughes, Cambridge City, Indiana, October 12.

Claim.—"Having fully described the nature of my improved machinery for making hominy and samp, what I claim therein as new are, the combination of the beating cylinder, arranged and constructed as set forth, with the adjustable discharging apertures, by means of which the hulls and eyes are separated from the grain, and the latter is retained within the range of the beaters for a shorter or longer period, according to the grade or size of hominy or samp which is desired."

32. For an *Improvement in Presses for Bundling Flocculent and other Substances;* Daniel Kellogg, Pittsfield, Michigan, October 12.

"My invention consists of a peculiar construction and arrangement of the press box, bed, and platen, whereby the substance being pressed may be single and double, or cross bound, while under pressure."

Claim.—"Having thus described my improved press, what I claim as new therein is, the combination of the pressing box, made with openings in its sides, with the platen and bed, turning on swivels, and formed with channels, so arranged as to admit of the passage of the needle and cord through the pressing box, for the purpose of singly and doubly binding fleeces of wool or other substances, while under pressure."

33. For an *Improvement in Gas Regulators;* Walter Kidder, Lowell, Massachusetts, October 12.

Claim.—"Having fully described my improved gas regulator, what I claim therein as new is, producing a uniform pressure of gas in the branch pipe which supplies the burners, by means of the inverted cup, the vibratory lever, and the induction valve, arranged and operating within the chamber of the branch pipe, substantially as herein represented and described."

34. For an *Improvement in Gas Regulators;* Walter Kidder, Lowell, Massachusetts, October 12.

Claim.—"Having fully described my improved gas economizing regulator, what I claim therein as new is, producing a uniform pressure of gas in the branch pipe which supplies the burners—which may not be varied by the number of burners supplied, nor by the variations of pressure in the main—by means of the counterpoising double inverted cups, the vibratory lever, and the induction valve, so combined and arranged, with reference to the main and the branch pipe, that one of the said inverted cups will be acted upon by the gas in the main, and the other by the gas in the branch pipe, as herein represented and described."

35. For an *Improvement in Gas Regulators;* Walter Kidder, Lowell, Massachusetts, October 12.

Claim.—"Having fully described my improved gas economizer, what I claim therein as new is, the producing at all times a proper and uniform pressure of gas in the branch pipe which supplies the burners, which will not be essentially varied by the number of burners supplied, nor by the variations of pressure in the main, by means of the induction valve, the vibratory lever, and the counterpoising inverted cup, combined, and arranged, and operating within the chamber of the main, substantially as herein represented and described."

36. For an *Improvement in Harness Saddle Trees;* Thomas Mardock and William C. Kellar, Cincinnati, Ohio, October 12.

Claim.—"Having described the nature of our improvements in harness saddle trees, what we claim therein as new are, the crupper loop, having a shank, which being inserted through the cantle into the pommel, is secured to the latter by the pad hook, in the manner described."

37. For an *Improvement in the Apparatus for Transporting Trains on Inclined Planes of Railroads;* Samuel McElfatrick, Dauphin, Pennsylvania, October 12.

Claim.—"I do not claim as my invention dividing the axles of the car, and providing the inner ends of the two parts with independent journals, as this has before been done; neither do I claim the use of an auxiliary track, running down into a pit: but what I do claim as my invention is, making the axles of the safety car in two parts, the inner end of each part being provided with an independent journal, constructed and operated as described, when this is combined with the auxiliary wheels and auxiliary converging track and pit, substantially in the manner and for the purpose specified."

38. For an *Improvement in Grinding Mills;* Oldin Nichols, Lowell, Massachusetts, October 12.

Claim.—"What I claim as my invention is, the pointed projections on the front edges of the teeth of the cylinder, when used in combination with the teeth in the concave formed with concavities in their front edges, substantially in the manner and for the purpose herein set forth."

39. For an *Improvement in Expanding Window Sashes;* Mighill Nutting, Portland, Maine, October 12.

Claim.—"What I claim as my invention is, the method of varying the pressure of the edges of the expanding sash against the jambs of the window frame, by means of the combination of the adjusting screws and springs with the set screws, or the equivalent thereof, for limiting the extent of the expansion of the sash, substantially as herein set forth."

40. For an *Improvement in Plough Fastening Devices;* James Robb, Lewistown, Pennsylvania, October 12.

Claim.—"I do not claim, exclusively of itself, hooking the land side of the mould board; but what I do claim as new and useful is, holding the share to its place by a tightening wedge, having a lip for lap or bite on the share, in conjunction with the headed or lip'd studs, for further securing the same."

41. For an *Improvement in Seed Planters;* James Robb, Lewistown, Pennsylvania, October 12.

Claim.—"I do not claim, exclusively of itself, giving to the drill tooth the curvilinear movement specified, as such is old; but what I do claim as my invention is, 1st, Causing the point of the drill tooth, when raised out of the ground, to slope backward, by the

arrangement of the drag bar attachment, the friction pulley, and the curve of the upper part of the drill tooth, to avoid breaking the tooth, as herein described.

"2d, I claim the combined device of endless screw and curved neck and pinion, for producing the result herein specified."

42. For an *Improvement in Burners for Spirit Gas Lamps;* Rufus W. Sargent, Philadelphia, Pennsylvania, October 12.

Claim.—"I do not claim the reservoir, burner tubes, or arrangement of the wick. What I claim as my invention is, the combination of the lower chamber or chambers with the upper chamber, for the purpose specified, viz: the lower chamber or chambers, answering the purpose of a heater, volatilize or turn into gas the fluid in the upper chamber, the flame being regulated as above described, and the whole arrangement being substantially as above set forth, without restricting myself by this claim to the precise form of the burner described."

43. For an *Improvement in Packing Water Wheels;* Erasmus Smith, Norwich, New York, October 12.

Claim.—"Having described my improved water wheel, what I claim as new therein is, the arrangement of the packing between the edges of the chamber or case and the wheels, in such manner that the packing on the lower portion of the chamber is adjustable from the interior, while the packing round the upper portion of the chamber is set up from the outside of said chamber, substantially as specified, so that the whole of the packing is on the upper side, and none of it under the case, and all capable of being set up or adjusted without the necessity of getting under the case."

44. For an *Improvement in Governors;* John Thompson, Buffalo, New York, October 12.

"The nature of my improvement consists in the use of cords, chains, rods, or their equivalent, when wound upon a spindle or otherwise, as hereinafter described, and combined with or attached to weights or fans, for the purpose of regulating the motion of steam engines, or for regulating the supply of fluids, &c."

Claim.—"Having described my invention and improvement in governors, what I claim as new is, the combination of the winding cords or chains, retarders or disks, hub, and spindle, arranged and operating in the manner and for the purpose substantially as herein set forth.

"I also claim operating the governor valve of steam and other engines, by the twisting and untwisting of a flexible cord or chain, or equivalent thereto, attached to revolving retarders, and to the driving pulley placed above the same, and detached from the spindle.

"I likewise claim constructing the clasp with shoulders upon each part, which fit against corresponding shoulders upon its opposite part, and prevent the opening of the clasp, when they are united by the screw, substantially as set forth."

45. For an *Improvement in Glass Buttons;* Arad W. Welton, Cheshire, Connecticut, October 12.

"My improvement consists in impressing upon a concave or underside of the glass centres of buttons, any desired figure, and painting or enamelling such figure with colors uniform or variegated."

Claim.—"What I claim as my invention is, the inserting of figures of uniform or variegated colors upon the inside of glass centred buttons, substantially in the mode above described."

46. For an *Improvement in Sewing Machines;* Otis Avery, Honesdale, Pennsylvania, October 19.

"The nature of my invention consists in using two adjustable spring needle bars, moving on the same plane obliquely towards each other from opposite sides of the cloth or other material to be sewn, for regulating the length of the stitch; also, the weight or its equivalent, for drawing through the cloth as fast as it is sewn and released by the needle, one of which is always in the cloth, to prevent it from being drawn entirely through."

Claim.—"Having thus fully described my invention, what I claim therein as new is, in combination with the needle bars, the spring holders and adjustable guides, through which the said bars pass, for the purpose of regulating the length of the stitch, substantially as herein described.

"I also claim, in combination with the apparatus for regulating the length of the stitch, the weight or its equivalent, for drawing the cloth forward, as it is alternately released

from the needles, by which means the feed motion is regulated and made dependant on the length of the stitch, substantially as described."

47. For an *Improvement in Spreading Lime and Manure;* Lewis Cooper, Coopersville, Pennsylvania, October 19.

Claim.—"What I claim as new and useful is, so constructing the pulverizing and fertilizing apparatus as to effect the several functions of pulverizing and distributing manures of various kinds at will, by so arranging the roller that it can be raised or depressed in the discharging opening of the bottom of the hopper to any required level, so as to discharge a larger or smaller quantity of material, previously brought to the desired degree of fineness in the hopper, and at the same time to act as a valve, to close more or less tightly the bottom of the hopper. The same roller likewise serving as a distributor of seed in sowing broadcast, without any alteration of the machine, substantially as herein set forth."

48. For an *Improvement in Tools for Cutting Pegs out of Boot Soles;* D. D. Allen, Adams, Massachusetts, October 19.

Claim.—"Having fully described the nature of my invention, what I claim as new is, 1st, the adjustable float or cutter, connected to a shank by means of the pin or pivot, which turns loosely in the bearing or standard, so as to permit the float to adjust itself to the proper positions to cut the pegs from the heel to the toe of the boot, in the manner herein set forth."

49. For an *Improvement in Grain Separators;* Peter Geiser, Smithsburg, Maryland, October 19.

Claim.—"What I claim as my invention is, the method herein described, of regulating the blast of winnowing machines, by means of a flap on the fan case, arranged and adjusted substantially as herein set forth.

"I also claim the reciprocating toothed bars, with the trough, whose bottom is divided into three portions, the lowermost being tight, and acting merely as a conveyor; the middle one acting both as a conveyor and screen, to separate the wheat from the straw, and allow it to pass into the winnower; and the upper or third portion acting as a conveyor for the straw, and a coarse screen, to separate therefrom the heads of unthreshed grain that would not pass through the lower screen, the teeth of the reciprocating bars moving the straw regularly along the trough, and working or shaking the grain and heads so effectually through the screens, that none is left to pass off with the straw when it is discharged from the upper end of the trough."

50. For an *Improvement in Printing Presses;* Lucius T. Guernsey, Montpelier, Vermont, October 19.

Claim.—"What I claim as my invention is, the combination of a reciprocating type bed, with an impression cylinder, which has the half-rotary (or reciprocating rotary) movement, and also a movement to and from the type bed, as herein set forth and described."

51. For an *Improvement in Seed Planters;* Edson Hart, New Albany, Indiana, October 19.

Claim.—"Having described the nature of my invention, what I claim therein as new are, the rail, with the rod or rods connecting it with the hopper, the said rods occupying traversing collars, with tightening screws, by means of which the relative distance of the axle and the feed shaft are adjusted, to suit different arrangements of gearing, according to the rate of feed desired."

52. For an *Improvement in Apparatus for Elevating and Discharging Bilge Water, &c.;* Nehemiah Hodge, North Adams, Massachusetts, October 19.

"The nature of my invention consists in combining with a series of tanks and tubes, or their equivalents, a ventilating or air tube, which has communication with the tanks for allowing the air to escape from the tanks as the water flows into them, the whole being so placed in the hold of a ship, or other sea-going vessel, for the purpose of elevating and discharging the water from the holds thereof, as that they shall be operated by the fore and aft or rolling motion of the vessel; thus making what I term 'a self-working ship's hydrant.'"

Claim.—"I am aware that rocker pumps have been constructed, to be operated by hand power; but in these no adequate provision has been made for receiving and retaining the water as it is raised up; besides, their action is limited to a continuous rapid propelling

power; whilst by my arrangement any varying inclination of the vessel from a horizontal line, however slow, puts the apparatus in operation, and as heretofore constructed, could not, without encumbering the hold of the vessel, be placed therein; I do not therefore lay claim to any such pumps: but what I do claim herein as new is, in combination with a series or system of tanks and tubes, or their equivalente, the ventilating tubes, substantially as described, for the purpose of elevating and discharging water from the holds of vessels; the whole being operated or worked by the motion of the vessel, as set forth."

53. For an *Improvement in Water Wheels;* Ira Jagger, Albany, New York, October 19.

Claim.—"I claim the application of an adjustable lip, sliding on the inner surface of the buckets of a turbine wheel, to regulate the openings between the outer edges of the buckets, and thereby the flow of water from the wheel, in manner and form substantially as set forth in the above specification, and thus adapting the lines of the turbine to the head of water and amount of work to be done, however varying."

54. For an *Improvement in making Soda Ash and Carbonates of Soda;* Henry Pemberton, Philadelphia, Pennsylvania, October 19.

Claim.—"Having fully described my invention and the means by which the same may be reduced to practice, what I claim therein as new is, 1st, the process of making soda ash by heating the mixture of sulphate of soda and carbonaceous matters, without the use of lime or any other foreign matters, as preparatory to converting the same into other products, substantially as described.

"2d, The process of treating the aqueous solution of the above heated products by carbonic acid, then boiling to dryness, to form a mono-hydrated carbonate of soda, to be treated again in the dry state, by carbonic acid, to form bi-carbonate of soda, as set forth in the specification."

55. For an *Improvement in Bedsteads;* Daniel W. Smead, Peru, Illinois, October 19.

"The nature of my invention consists in the construction of a movable or swinging foot board, that may be raised or lowered, and so as to hold the bed clothes in their proper places."

Claim.—"What I claim as my invention is, the swinging foot board, to serve the purpose of a clasp for securing the bed clothes, it being held down by a ratchet and pawl, or otherwise."

56. For a *Sash Stopper and Fastener;* James D. Smith, New Britain, Connecticut, October 19.

Claim.—"What I claim as my invention is, the construction of a window or sash stopper, operating by a winding spiral spring; the whole arranged and combined substantially as herein described."

57. For an *Improved Life Preserving Seat;* George P. Tewksbury, Boston, Massachusetts, October 19.

Claim.—"I claim the said improved life preserving seat, as made of a combination of the seat, the head or block, the air-tight vessel, and the connecting rods or grasping bars, applied together and used substantially in manner and for the purpose as specified."

58. For *Improved Burglar-Proof Plates for Doors, Safe Walls, Vaults, &c.;* Linus Yale, Jr., Newport, New York, October 19.

Claim.—"What I claim as new and of my invention is, a method of making burglar-proof plates, doors, and chests of iron, which, in the process of being cast into the form required for such plates, doors, and chests, surrounds or imbeds malleable iron rods or bars, or their equivalents, arranged substantially as described and shown by the specification and drawings herewith accompanied, or in an equivalent manner.

"I do not claim in said plates, doors, and chests, the casting in of straight rods or bars of malleable iron, or their equivalents, imbedded parallel with each other in only one general direction."

59. For an *Improvement in the Mode of Forming Crucibles and other Articles of Earthen Ware;* John Akrill, Williamsburgh, New York, October 26.

Claim.—"I do not limit myself to rotating the mould, as the cutter and burnisher may be rotated; neither do I limit myself to any particular character of earthy and plastic material of which the crucible is to be formed; what I claim is, 1st, the cutters on the stock in combination with the mould, to either or both of which a rotary motion is given, so as to remove the surplus material and shape the crucible, as described and shown."

60. For an *Improvement in Boot Crimps;* Luman Barrett, Gainesville, New York, October 26.

Claim.—"I do not claim as my invention the form of the brake, or of the clamps; but what I do claim as my improvement on crimping machines is, arranging a spring lever upon the back of the crimping lever, substantially in the manner and for the purpose herein set forth."

61. For an *Improved Bitt or Drill Stock;* Dexter H. Chamberlain, Boston, Massachusetts, October 26.

Claim.—"What I claim as my invention is, the improvement of combining with the bell crank, A, and handle, B, of the bitt stock, the rotary bitt holder or shaft, E, the shaft, K, the pulleys, M, L, and endless band, N, (or two gears as stated,) and the pulleys, G, I, and band, H, or gears, substantially as described, and for the purpose of accelerating the rotary motion of the drill beyond that of the bell crank, when the instrument is used as stated."

62. For an *Improvement in Gilding Daguerreotypes;* Charles L'homodieu, Charleston, South Carolina, October 26.

Claim.—"So far as I can ascertain, I am the first to succeed, in a practicable degree, in gilding daguerreotype plates with cyanide solutions; and the first to have gilded those plates at all with cyanide solutions and a single circle of zinc; I therefore claim my mode of gilding daguerreotype plates, substantially as described; that is to say, by the employment of the electric current, and of hot solutions of the cyanides of gold, previously boiled; and I claim the kind of zinc circle or tray designated by the figure 6."

63. For an *Improvement in a Machine for Making Bags of Paper;* Francis Wolle, Bethlehem, Pennsylvania, October 26.

"This invention consists in certain devices, by the combined operation of which, pieces of paper of suitable length are given out from a roll of the required width, cut off from the roll, and otherwise suitably cut to the required shape, folded, their edges pasted and lapped, and formed into complete and perfect bags, which, when dried, will be ready for use."

Claim.—"What I claim as my invention is, 1st, giving the proper form to the piece of paper or material from which the bag is to be made by means of the shears, and which cut on the edges of, or on edges attached to the stationary table or inclined plane on which the paper is delivered, and cut out a rectangular piece as shown in figures 6 and 8, from that part which is to form one side of the bag, so as to leave a lapping piece on the part which is to form the other side of the bag, as herein substantially set forth.

"2d, The pasters, in combination substantially as described, with the feeders, which revolve or pass through the paste, and supply them with a proper quantity for pasting each lap.

"3d, The combination of the creasers and the lappers, with the intermittingly moving feed rollers and aprons, in the manner substantially as described, the said creasers and lappers being brought successively into operation on the bags, during the intermissions in the motion of the feed rollers, as set forth."

64. For an *Improvement in Machinery for Combing Wool;* Samuel C. Sister, and George E. Donisthorpe, County of York, England, October 26; patented in England, March 20, 1850.

Claim.—"Having set forth our invention, we would have it understood that what we claim is the combination, the endless belt, and the rotary spring bar or bars, (or equivalent therefor,) operating as described, by which we draw the fibres from the gill combs, and carry them forwards to the revolving brush; the whole constructed and made to operate substantially as specified.

"And we also claim the peculiar manner in which the revolving brush, that takes the wool from the nipping apparatus and conveys it to and lays it upon a circular band or belt of upright teeth, is constructed and operated, the same consisting in making the said brush in sections, and combining therewith mechanism, by which not only a range of these sections can be thrown into a straight line with each other, but another and opposite range can be thrown into a curved or bent line, as herein before described, the said mechanism for effecting the movements of the sections of the ranges, being as hereinbefore explained and as represented.

65. For an *Improvement in Watch Keys;* Charles E. Jacot, City of New York, October 26.

Claim.—"I claim the key retained in a countersink in the back plate of the watch, by a spring or similar means, as herein set forth."

66. For an *Improvement in Hot Air Furnaces;* Augustus M. Rice, Assignor to himself and Sanford H. Lombard, Boston, Massachusetts, October 26.

Claim.—"What I claim as my invention is, the improved mode of making and supporting the grate, viz: by the combination of a single journal, a socket piece, and a crank key shaft, as applied to the furnace and grate, and made to operate substantially as specified.

"I also claim the peculiar combination and arrangement of the horizontal flues, the vertical flues, and the flue space surrounding the chamber of combustion, the whole being essentially as above specified.

67. For an *Improvement in Cooking Stoves;* Hosea H. Huntley, Assignor to David T. Woodrow, Cincinnati, Ohio, October 26.

Claim.—"What I claim as new is, giving the arched fire-plate great elevation above the level of the oven top on which its upper edge rests, and giving great capacity thereby to the air chamber formed by the arched fire-plate and oven plates; the under side of the arched fire-plate being furnished with ribs which divide this air chamber into flues transverse the stove, so that the full force of the fire draft is thrown upon the boiler openings and from the top plate of the oven, thereby protecting it from a surcharge of heat, and so that in concert with the flues around the ovens as described, the air must pass from the openings in the side plates to the centre, and thence back to the sides of the stove to the flues leading to the front of the stove, for the purpose of being thrown, very thoroughly heated and in great quantity, around the front oven, and when the damper is opened, around both ovens; it being distinctly understood that I do not claim a fire-plate in itself, nor ribs for guiding air along a fire-plate in themselves, but only my mode of pitching the arch of the fire-plate, and arranging the air chamber, in combination with the flues and damper, as described, so as to produce the aforementioned effect."

68. For an *Improvement in Hot Air Furnaces;* Apollos Richmond, Assignor to A. C. Barstow & Co., Providence, Rhode Island, October 26.

Claim.—"What I claim as my invention is, a spiral radiator, constructed substantially as above described, whether the pipes be of a round, square, or oval form in section, or the coils be round, square, or other shape."

69. For an *Improvement in Locks;* F. C. Goffin, City of New York, October 26.

"The nature of my invention consists in the employment or use of a guard, which, with the lever which intercepts the bolt, or prevents it from being withdrawn, rests or bears upon the tumblers; said guard requiring to be freed from the tumblers as well as the lever before the tumblers can be adjusted by the key so as to allow the lever to fall into the recesses in the tumblers, and enable the bolt to be withdrawn."

Claim.—"I do not claim the tumblers or the lever, for they are employed in many locks, and have been long known; but what I claim as my invention is, the employment or use of a guard, constructed, arranged and operating in the manner substantially as herein described, whereby the lock is prevented from being picked, by obtaining a pressure upon the bolt, as set forth."

70. For an *Improvement in Constructing Ploughs;* Albert Gardner, for himself, and as Administrator of the Estate of Wm. L. Hunter, deceased, Cincinnati, Ohio, October 26.

Claim.—"What I claim as the invention of the aforesaid William L. Hunter and myself, in the construction of the above described plough, is, bolting the standard mould board, landside, and share, to the block or its equivalent, instead of bolting or fastening the parts to each other, as has been practised heretofore, which block may be connected to the beam by a bolt, or otherwise, substantially as described and represented."

Re-issue for October, 1852.

1. For an *Improvement in the Seeding Apparatus of Seed Planters;* Lewis Moore, Bart, Pennsylvania; dated July 2, 1850; re-issued October 12, 1852.

Claim.—"Having fully described my improvements in seeding machines, I wish it to be understood that I do not claim a reciprocating gauge plate, having apertures parallel

and corresponding with apertures in the bottom of the hopper, as this I am aware is in use in other machines; but what I do claim as my invention is, the employment of a reciprocating gauge plate, when provided with feeding apertures in combination with corresponding apertures in the hopper bottom, which have their sides oblique to the sides of the apertures in the said reciprocating plate, and when combined with a device for giving it a variable reciprocating motion, for the purpose of sowing the seed constantly and uniformly, and varying the amount at pleasure, while the machine is moving, by simply varying the extent of its reciprocating motion, as herein described.

"I also claim the pivoted rod, and the vibratory lever, which is provided with apertures arranged in the arc of a circle whose centre is at the pivoted end of the rod, in combination with the curved or undulating disk and the guage plate, substantially as herein described, for the purpose of imparting to the gauge plate a reciprocating motion, which may be varied at pleasure by the operator, by inserting the rod in one or another of the apertures in the lever, at different distances from its fulcrum."

DESIGNS FOR OCTOBER, 1852.

1. For a *Design for a Cooking Stove;* Charles B. Tuttle, Amherst, New Hampshire, October 5.

Claim.—"What I claim as my invention or production is, the ornamental design for a cooking stove, substantially as represented in the accompanying drawings."

2. For a *Design for a Grate Frame and Summer Piece;* Adam Hampton, New York, October 5.

Claim.—"What I claim therein as new is, the combination and arrangement of the ornamental figures herein represented, the whole forming an ornamental design for a grate frame and summer piece."

3. For a *Design for a Table Frame and Legs;* Walter Bryant, Boston, Massachusetts, October 5.

Claim.—"What I claim as my production is, the new design, consisting of the scroll, vine, and leaf work, herein above described and represented in the drawings, for the side piece, leg, and cross brace of a table."

4. For a *Design for a Grate Frame;* James L. Jackson, City of New York, October 12.

Claim.—"What I claim as new is, the combination and arrangement of the ornamental figures herein represented, the whole forming an ornamental design for a grate frame."

5. For a *Design for a Parlor Stove;* N. S. Vedder, Troy, New York, October 12.

Claim.—"What I claim as new is, the ornamental design and configuration of top and front stove plates, such as is herein described and represented in the annexed drawing."

6. For a *Design for a Cooking Stove;* Elihu Smith, Albany, New York, October 19.

Claim.—"What I claim as my production is, the combination and arrangement of ornamental figures and forms, represented in the accompanying drawings, forming together an ornamental design for a cooking stove."

7. For a *Design for Forks, Spoons, &c.;* Robert Taylor and Robert D. Laurie, Philadelphia, Pennsylvania, October 19.

Claim.—"We do not claim the outline of the spoon, fork, ladle, &c.; but what we do claim is, the design and configuration of the ornaments for spoons, forks, ladles, knives, sugar tongs, &c., above described and set forth in the accompanying drawings."

8. For a *Design for a Cooking Range;* Benjamin Wardwell, Fall River, Massachusetts, and Ephraim R. Barstow, Providence, Rhode Island, October 19.

Claim.—"We claim the design consisting of the combination of the wheat sheaf, running vine, and enclosing fillet or bead, as placed on each of the oven or fire place or chamber doors.

"And we also claim the ornamental design on either of the plates, as described."

9. For a *Design for a Cast Iron Cradle;* Pelatiah M. Hutton, Troy, New York, October 26.

Claim.—"What I claim as my invention is, the design and configuration of the orna-

ments upon the body and upon the sectional parts, combined as in the drawing hereunto annexed, to form an ornamental iron cradle."

10. For a *Design for a Cooking Stove;* James Wager, Volney Richmond, and Harvey Smith, Troy, New York, October 26.

Claim.—"What we claim therein as new is, the above described ornamental design and configuration of the plates as represented."

NOVEMBER.

1. For an *Improvement in Pile Wires and Pincers for Weaving Pile Fabrics;* Erastus B. Bigelow, Clinton, Massachusetts, November 2.

Claim.—"Having pointed out the nature of my invention and its mode of operation, I would remark that I do not wish to confine myself to the precise form of the parts represented; nor do I claim as new constructing them for hand looms; but what I do claim is, making one part of the pile wires which is to be grasped by the pincers, wedged form, or oval shaped, in combination with grooves in the jaws of the pincers to conform thereto, substantially in the manner and for the purpose specified."

2. For an *Improvement in Edge Planes for Shoemakers;* Nicholas Bucher, Weedsport, New Jersey, November 2.

Claim.—"What I claim as my invention is, securing the plane iron, or knife, in a sliding tung, passing through a mortise in the body or handle of the plane, substantially as herein set forth, whereby, with great simplicity of construction, I obtain the facility of adjusting the instrument to the thickness of the sole of the boot or shoe, and of employing the draw cut."

3. For an *Improvement in Sewing Machines;* Christopher Hodgkins, Boston, Massachusetts, November 2.

Claim.—"What I claim as my invention is as follows: I do not herein intend to claim in the mechanism for feeding the cloth, "a notched bar which has a vertical or up and down motion, for fastening the cloth upon, and relieving it from the notches of said bar, by striking it against a yielding plate, and a lateral motion, or motion forwards and back;" but what I do claim as an improvement therein is, the employment of one or more burr wheels, *g*, applied to the carriage, K, and kept continually against the cloth by a spring, (so as to preserve the cloth from falling away from the spring plate or presser over it,) in combination with a spring brake, *k*, operated as described, the whole being combined and made to operate together, substantially as specified.

"And in combination with the presser, G, and the lower needle, I claim a mechanism by which an increase of thickness of the cloth is made the lower needle to the left, the distance required to bring it into correct position, with respect to the upper needle, so as to prevent the said upper needle from passing into the cloth, before passing into the bow of the thread of the lower needle, as set forth.

"And I claim the combination of the slide rod, m^2, the box, n^1, screw, S, slotted arm, *v*, shaft, *w*, arm, *x*, connecting rod, f^1, slide, a^1, stationary plate, b^1, and cam plate, c^1, as applied to the fulcrum pin, W, of the lever, V, and to the presser, for the purpose of moving the lever, with respect or nearer to the cam, U, for the purpose and in the manner herein described."

4. For an *Improvement in Vibrating Propellers;* Franklin Kellsey, Middletown, Connecticut, November 2.

Claim.—"What I claim as my invention is, the combination in a field or row, of a multiplicity of inclined planes, or sculls, secured by gudgeons on one of the sides thereof, in a frame vibrating horizontally, and the graduation of their propelling velocities, by a similar multiplicity of check pins or stops, so adapted to the respective planes or sculls, that, in vibrating the same, they may propel, as nearly as possible, in equal times, and thereby reduce the propelling principle of the tail of a fish, as nearly as may be, to mechanical purposes, substantially as above described, for the propelling of all kinds or classes of vessels, or boats, by the power of steam, or other power, and with or without sails, as occasion may require."

5. For an *Improvement in Gas Metres;* John Laidlaw, City of New York, November 2.

Claim.—"What I claim as my invention is, the chamber, B, and syphon, M, in combination, in the manner substantially as described, with the pipes, I, J, or other pipe or

pipes, having an opening or openings, similar to J, at the required level of the liquid in the metre, for the purpose of preserving the level and discharging the surplus liquid from the metre."

6. For an *Improvement in Saw Gummers;* J. D. Otstot, Springfield, Ohio, November 2.

Claim.—"Having thus fully described my improved apparatus for gumming saws, what I claim therein as new is, the combination of the frame, shoe, and set screws, in the manner and for the purposes set forth."

7. For *Improved Manufacture of Wire Ferrules;* Wm. T. Richards, New Haven, Connecticut, November 2.

"My improvement consists in manufacturing the wire ferrule, that both ends of it may be smooth, true, and at right angles to its length."

Claim.—"I am aware that wire ferrules have been made, when the coil has been cut directly across the wire; I therefore do not claim the manufacture of wire ferrules, as such, as my invention; but what I claim is, the manufacture of ferrules from iron wire, by cutting them from a helical coil, in such a manner that both ends of each ferrule will be perfectly smooth, true, and square across, at right angles to the length, so that no other finishing of the ends will be needed, to render them fit for use, and so that when soldered, they will be the most convenient and durable ferrules which can be made, when manufactured in the manner substantially as described."

8. For an *Improvement in Seed Planters;* Charles Randall, Palmyra, Georgia, November 2.

"My invention consists in a novel and peculiar arrangement of drill, constructed with particular reference for adapting it to the dropping of cotton seed, but it can be used with nearly equal advantage for a variety of other seed."

Claim.—"Having thus fully described my invention, what I claim as new is, the two disks, combining a hopper, plough, and carrying wheel, substantially as described, in combination with the segment plates, or their equivalents, by which the discharge of seed is regulated, operating substantially as in the manner and for the purpose herein fully set forth."

9. For an *Improvement in Cooking Stoves;* Manly C. Sadler, Brockport, New York, November 2.

Claim.—"What I claim as my invention is, the guard plate for carrying the products of combustion under the oven, that part thereof may pass around and over it to the front, and the rest continue to and up the back flue, substantially as specified, in combination with the recess in the rear of the fire chamber, for extending a portion of the fire near to the oven, and the deflexion plate for dividing the draft and carrying it towards each end of the oven, substantially as and for the purpose specified."

10. For an *Improvement in Seed Planters;* Francis Townsend, Cambria, New York, November 2.

Claim.—"In combination with the regular and positive discharge of seed, by means of the ordinary seed distributor of seed drills, I claim the supplemental or occasional discharge of seed, by a supplemental seed distributor, put in and out of action at the discretion of the operator of the machine, substantially as herein set forth."

11. For an *Improvement in Seed Planters;* Constant S. Trevitt, Ellicottsville, New York, November 2.

Claim.—"What I claim is, the combination of the perforated register plate, the adjusting screw, and the springs arranged and operating as described."

12. For an *Improvement in Seed Planters;* Henry Vermillion, Rising Sun, Maryland, November 2.

Claim.—"Having described my improvement in the distributing apparatus of seed planters, it will be understood that I do not mean to claim the use of a reciprocating gauge plate, having oblique feed openings therein, operating in combination with openings of different obliquity, in the grating plates and bottom of the hopper, for increasing or

diminishing the feed of the seed to be sown, while the machine is in motion, by increasing or diminishing the traverse or sliding movement of the gauge plate; but what I do claim as my invention is, the employment of the pivoted oscillating plate, when made with oblique openings on opposite sides of its centre, reaching to and forming outlets at the circumference of said plate, in combination with segmental or other similar openings above the oblique opening, and a central annular opening in the ring plate, whereby during the oscillation of the pivoted plate, the seed is not only discharged from the outlets of the oblique openings over the circumference of the ring plate, but also through the central annular opening of the ring plate from the centreward ends of the oblique openings."

13. For an *Improvement in Ventilators;* David Wells, Lowell, Massachusetts, November 2.

Claim.—"I do not claim a ventilator made of a series of flat plates, arranged in a circle, with openings between them; nor do I claim one made of a series of plates arranged in a circle or around an axis, and with openings between them, and each made to stand tangential or curved (transversely) to the arc of a circle or curved line of the set of plates: but what I do claim as my invention is, a ventilator constructed of a single series of curved or angular plates and openings, and capped, connected with a tube or flue, and having each plate curved or made angular convexly or concavely, out of the general line of their arrangement, around a common axis, as represented in the drawings."

14. For an *Improved Method of Securing Vault and Safe Doors, &c.;* F. C. Goffin, City of New York, November 2.

"The nature of my invention consists in securing or fastening the doors of safes, bank vaults, &c., &c., by means of movable flanches attached to the door, and arranged as will be hereafter described; said flanches forming a continuous bolt all around between the door and its mouth piece, by which means the door is rendered more secure against fire and force, and less liable to get out of order, than by any other mode of construction."

Claim.—"Having thus described the nature and operation of my invention, what I claim as new is, securing or fastening the doors of safes, bank vaults, &c., by means of movable flanches, arranged and attached as herein shown and described, by which means a continuous bolt is formed all around between the door and its mouth piece, preventing the admission of air into the safe, which is thereby rendered secure against fire, and the door against force."

15. For an *Improvement in Mode of Counterbalancing Harnesses in Looms;* James Greenhalgh, Waterford, Massachusetts, November 2.

Claim.—"I do not claim the mere upright position of the jacks, or the mere counterbalancing of the harness; but what I do claim is, the construction of the long double heddles or jacks, in such a manner, and so hanging them on the axle by a short arm, or its equivalent, that in their vibrations neither end of them shall pass beyond a vertical plane passing through the axle on which they rock or oscillate, so that the weight of the jacks shall be thrown outside of their points of suspension; thus counterbalancing the weight of the harness."

16. For an *Improvement in Self-Acting Mules;* Wanton Rouse, Taunton, Massachusetts, November 2.

Claim.—"Having fully described my invention, I will proceed to state what I claim, without confining myself to the precise construction and arrangement of the parts, or to the precise manner of operating them.

"1st, I claim backing off or reversing the spindles, to unwind the yarn from them, and regulating or altering the amount of backing off, as the building of the cops progresses, by means of a step or incline of varying form, extending along a revolving cam or its equivalent, substantially such as is exemplified in the part from 5 to 25, on the cam n, the said step or incline governing the revolution of the spindles.

"2d, I claim the mechanism for making the finger through the irregular surface of the cam n, or its equivalent, acts upon the mechanism which drives the spindles in backing off and building on, to traverse the said cam, or equivalent, and keep it to the surface, consisting of the screws, the nut, the cord or chain, the lever, and stud, operating in combination, in the manner substantially as described."

17. For an *Improvement in Machines for Drilling Stone;* Lemuel P. Jenks, Boston, Assignor to Joseph W. Page, West Roxbury, Assignor to George A. Gardner, Boston, Massachusetts, November 2.

"The nature of my invention consists in providing an arrangement, whereby a reciprocating motion of a drill in combination with a rotation of the said drill is secured, in connexion with a contrivance for feeding forward the said drill into the rock; with this, I have also a contrivance, whereby I can at pleasure graduate the rapidity of the rotation, and also the rapidity of the feeding forward of the same, by either one movement or by two separate movements."

Claim.—"The arrangement of the mandrel head, pawl, and ratchet wheel, as sunken into the cross head, I believe to be an original and valuable improvement; but I do not think it necessary to claim it. The same remark applies to that of the cross cut valve, as applied to steam drills; though since my invention of it, I have learned that a similar arrangement has been applied to pumps. The same remark as to originality and valve, applies to the arrangement of the bars or rods, to effect the turning movements, as swinging on their centres; but I do not feel certain as to their priority, and have not at present the opportunity to ascertain: I therefore do not claim that priority. The side swinging of the frames bearing the drill, is also a new and valuable feature; but I do not think it necessary to claim it.

"But the claim which I do make herein as for my own invention is, the arrangement, (in a swinging or other frame,) for the purpose of drilling rods, of two cross heads, the one with a reciprocating motion, and the other connected therewith and bearing the drill, with a reciprocating and progressively advancing motion, substantially as described; and this, however such alternate advance and recession may be effected.

"I also claim the arrangement of, substantially, a sliding bar, for the purpose of changing both the rate of rotation and the rate of advance of the drill, by one movement, for the purpose and in the manner substantially as described.

"I do not claim the ratchet wheel and pawl holder, operated by the inclined groove, by itself; but I claim the making the ratchet cylinder, or equivalent rotating arrangement, sliding upon the mandrel or drill stock as the same advances, in such manner as that the pawl holder projection retains its place in the inclined groove, substantially as herein described."

18. For an *Improvement in Sewing Machines;* John G Bradeen, Boston, Assignor to himself and George Perkins, Malden, Massachusetts, November 2.

Claim.—"I claim as my improvement the two rotating draft hooks, or their equivalent, separate from the needles, in combination with the two needles and two thread guides, made to be operated together substantially as specified.

"And I claim the improvement of so constructing and operating the needles and thread guides, that each needle, directly after passing into and through the cloth, shall pass through the thread guide which is on that side of the cloth opposite to the side of it in which the needle first enters; meaning to claim the arrangement of each needle and its thread guide, respectively, on opposite sides of the cloth, they being constructed and operated in the manner specified. In F. R. Robinson's machine, they are arranged and made to operate on the same side of the cloth.

"And I also claim the combination of the rocking thread lifter, or its equivalent, with the needle and presser, the said thread lifter being operated as described, by the thread guide lever, or any other proper means."

19. For an *Improvement in Hand Seed Planters;* William Bullock, Philadelphia, Pennsylvania, November 2.

Claim.—"What I claim therein as new and of my invention is, 1st, A seed planter, having a tube or tubes, which, in operating the planter, is or are closed when placed in the ground, and so arranged that it or they can be opened while in the ground, for the purpose of letting the seeds out.

"2d, The arrangement of two or more tubes in such a manner, that the operator can place the seeds in a hill, at specified distances apart.

"3d, The feeders, having a sloping cavity at the outer ends, and being so arranged that as the seeds are carried up, they will slide out and pass into the tubes.

"And, 4th, the arrangement of the feeders and jaws or valves of the tubes, in connexion with the handle, by which the machine is carried, so that the feeder and jaws or valves can be operated by the same hand with which the machine is carried."

MECHANICS, PHYSICS, AND CHEMISTRY.

For the Journal of the Franklin Institute.

United States Steam Frigate Mississippi. By Chief Engineer B. F. Isherwood, U. S. Navy.

The steam frigate *Mississippi*, built at Philadelphia, and launched May 21, 1841, may be considered as the commencement of the United States steam marine; her sole predecessor, the *Fulton*, being adapted for harbor defence only, and incapable of ocean navigation. The *logs* for the *Mississippi's* entire time of steaming having lately come into my hands, I have prepared carefully from them a summary of her performance, which will be found in tables 1, 2, 3, and 4, hereafter given. These tables embrace all that portion of the vessel's performance where the logs were full, and where the steaming was uninterrupted for such a length of time, with unchanged conditions of weather, sea, throttle, cut-off, steam, &c., as to promise reasonable accuracy for the mean. They of course exclude a considerable amount of steaming for short distances, and where the logs are imperfect and unreliable.

In examining these tables, the reader must bear in mind the manner in which the data was obtained. The speed of the vessel was ascertained by the common chip log, and the result is probably in no case within half a knot of the truth; as a general thing, the speed is over-logged. The double strokes of piston were occasionally obtained from a counter, but generally by counting by the sand glass every quarter hour, and logging the mean—not a very close approximation. The steam pressure was obtained in a similar manner, by taking a mean of quarter hour observations; while the expenditure of coal was taken by *measure*, instead of *weight*—a certain average weight being allowed for each measure; of course, there were inevitable errors here, owing to the measure never being filled twice alike, and also to the fact, that the same measure of larger lumps would weigh less than the same measure of smaller lumps.

The state of the sea, the direction and kind of wind, &c., recorded in the logs, are very unreliable, as they are judged of entirely according to the fancies and sensations of the observers. What would be called a rough sea by one, would be called a moderate sea by another, and so on. The direction of the wind, as well as its force, is the *apparent* direction and force to an observer on the vessel's deck; where, owing to the progressive movement of the vessel, what appears to be, and is logged as a gentle wind ahead, is in fact a calm, while a calm is a gentle wind aft, and so on. For the same reason, a wind whose direction is logged forward the beam, has its direction abaft the beam.

Still, notwithstanding all these errors, the mean of many hours' performance, by the resulting correction of errors thereby obtained, may be depended on as a reasonably close approximation to the truth, sufficiently so for all practical purposes; for the probability is the same, that of a number of observations varying from the truth, as many will be too high as too low; the greater, therefore, the number of observations the nearer will the mean approach the truth. From these considerations, I am per-

suaded that the *means* of tables 1, 2, 3, and 4, may be received and argued upon with confidence. Before, however, discussing their results, it will be useful to give the dimensions of the vessel, machinery, &c., the former of which I have obtained from the constructor.

HULL.—Length over all,	228 feet 9 inches.
Length from aft side of rabbet of post at cross seam to fore side of rabbet of stern at the height of first port-sill,	223 "
Extreme breadth,	40 "
Moulded breadth,	39 "
Height from lower edge of rabbet of keel to first port-sill amidships,	28 "
Depth of hold,	23 " 6 "
Depth of keel and false keel, clear of bottom plank,	2 "
Mean (Constructor's) load draft, *inclusive* of keel, &c., (2 feet,)	20 " 1½ "
Length of mean load line, including both rabbets,	219·71 feet.
Area of immersed amidship section at 20 feet 1½ inch mean draft,	651·3 square feet.
Area of mean load line,	7701 " "

Displacements at the following mean drafts of water, including keel.

Drafts.	Tons of sea water. 2240 lbs. per ton.
12 feet,	1332·16
14 "	1723·68
16 "	2132·81
18 "	2556·52
20 "	2991·80
20 " 1½ inch,	3022·00

Weights of hull and every thing ready for cruising, except machinery and fuel.

	Tons of 2240 lbs.
Hull,	1279·30
Masts, yards, &c.,	52·21
Spare spars,	5·73
Rigging, blocks, and iron work for rigging,	30.12
Sails and awnings,	10·2[illegible]
Cables, anchors, and appurtenances,	63·6[illegible]
Nine boats, with oars,	10·47
Armament, (gun carriages, pivots, breachings, &c., for two 10-inch and four 8-inch guns,)	32·90
Cases for powder,	5·24
Powder,	2·02
Shell and shot boxes,	1·11
Forty solid 8-inch shot,	1·25
Tanks, casks, kids, cans, &c.,	19·02
15,092 gallons of water at 8·34 pounds,	56·20
Provisions for 200 men for four months,	43·50
226 men, with baggage, at 225 pounds, (no engineer or fireman,)	22·70
Fuel for galley,	21·60
Galley and fixtures,	4·7[illegible]
Furniture for cabin, ward room, &c.,	2·73
Master's stores,	1·80
Carpenter's "	5·83
Gunner's "	4.02
Boatswain's "	8·95
Surgeon's, Purser's, and Officer's stores,	3·52
Engineer's stores,	8·34
Engineers and Firemen,	4·42
Total,	1701·57

RIG.—The *Mississippi* is barque-rigged, and spreads 19,030 square feet of canvass in the nine principal sails.

ENGINES.—Two side lever engines, with cast iron frames, and balance puppet steam and exhaust valves. The steam valve is used with Stevens' arrangement, as a cut-off valve.

Diameter of cylinders,	75 inches.
Stroke of piston,	7 feet.
Space displacement of both pistons per stroke,	429·5 cubic feet.
Diameters of the disks of the steam and exhaust valves,	13¾ and 14¾ inches.
Area of steam and also area for exhaust through the valves, each,	319·362 square "
Diameter of air pump,	46½ inches.
Stroke of air pump piston,	3 feet 8 "
Space displacement of both pistons of air pumps per stroke,	86·5 cubic feet.
Capacity of condensers,	150 " "
Diameter of main shaft,	17 inches.
Steam space between cut-off valves and pistons, one end of both cylinders,	21·52 cubic feet.
Length occupied by engines alone,	31 feet.

Weight of Engines complete.

Cast iron,	430,769 pounds.
Wrought iron,	250,582 "
Wrought copper,	16,496 "
Wrought steel,	1,138 "
Brass castings,	35,470 "
Total,	734,455 "

PADDLE WHEELS.—Diameter from outside to outside of rings, 30 feet.

Number of paddles in each wheel,	21.
Length of each paddle,	11 feet.
Width " "	30 inches.

Weight of Paddle Wheels complete.

Cast iron,	16,579 pounds.
Wrought iron,	29,368 "
Oak paddles,	14,448 "
Total,	60,395 "

BOILERS.—(PLATE III.)

Four copper boilers, with double return ascending flues. The boilers are placed in pairs, back to back, with one smoke chimney in common.

Length of each boiler, including its smoke connexions,	16 feet 9 inches.
Breadth " "	13 "
Height " " exclusive of steam chimney,	12 " 1½ "
Solidity of the circumscribing parallelopipedon of each boiler,	2640·22 cubic feet.
Area of the total heating surface in the four boilers,	5400 square "
" " grate " " "	268 " "
Aggregate cross area of lower arches at bridge in the four boilers,	72·026 " "
" " " " at back end of boiler "	52·693 " "
" " " of middle row of flues in the four boilers,	44·68 " "
" " " of upper " " " "	44·68 " "
Cross area of the smoke chimney,	44·18 " "
Height of smoke chimney above the grates,	65 feet.
Capacity of steam room in the four boilers and steam chimney,	1770 cubic feet.
" " " " " steam chimney, and steam pipes,	1876 " "

PROPORTIONS.—Proportion of heating to grate surface, 20·149 to 1·000

Proportion of grate surface to aggregate cross area of lower arches at bridge,	3·721 "
" " " " of lower arches at back of boiler,	5·086 "
" " " " of middle row of flues,	6·000 "
" " " " of upper " "	6·000 "
" " " " of smoke chimney,	6.066 "
Square feet of heating surface per cubic foot of space displacement of pistons per stroke,	12·573.
Square feet of grate surface per cubic foot of space displacement of pistons per stroke,	0·544.

Weights.

Brass castings,	16,182 pounds.
Iron castings, exclusive of grate bars,	2,427 "
Grate bars, (165 pairs and 12 single bars,)	22,079 "
Wrought iron, exclusive of smoke chimney,	17,509 "
Iron smoke chimney,	11,468 "
Wrought copper,	681 "
Four copper boilers and steam chimney, including braces and rivets only, not other appurtenances,	227,811 "
Total weight of boilers and appurtenances,	298,157 "
Weight of sea water in the four boilers,	183,680 "
The coal bunkers weigh	38,276 "
And contain of bituminous coal,	550 tons.

Cost of the Mississippi.

Cost of labor, all inclusive except machinery,	$129,344
" materials,	175,020
" machinery, except boilers,	167,583
" boilers,	81,901
Total cost of vessel,	$553,848

In the construction of the engines there was employed labor 16,658¼ days, at the average rate of $2·25 per day. Labor on patterns, 2302¾ days.

Repairs on the Hull of the Mississippi.

Cost of repairs done in 1845,	$10,300
" " 1847,	8,740
" " 1848,	3,630
" " 1849,	66,060

Repairs on the Machinery of the Mississippi.

Cost of repairs done in 1845,	$17,841
" " 1847,	2,855
" " 1848,	1,335
" " 1849,	61,967
" " 1852,	72,952

The total length in the vessel occupied by engines, boilers, coal bunkers, paddle wheels, and fire and engine rooms, is 113 feet.

PERFORMANCE OF THE MISSISSIPPI.

The performance of the *Mississippi* has been divided into four parts, and a summary of each given in tables 1, 2, 3, and 4. Tables 1 and 2 comprise the steaming done on the coast of the United States, in the Atlantic Ocean, and in the Gulf of Mexico; with the diameter of the paddle wheels 28 feet from outside to outside of paddles, and burning the Cumberland bituminous coal. In table 1 is given the performance under steam alone; in table 2 is given the performance under steam and sail.

Tables 3 and 4 comprise the steaming done in the Mediterranean and in crossing the Atlantic, from June 8th to June 12th, 1849, making 24 hours in table 3, and 60 hours in table 4. The paddle wheels were 28 feet diameter from outside to outside of paddles, and for the remainder of the performance contained in these tables it was 29 feet from outside to outside of paddles.

TABLE I.—Performance of the Mississippi under steam alone in the Atlantic Ocean and Gulf of Mexico, between October 24, 1845, and March 13, 1847.

Date.	Number of hours.	Speed of vessel in knots of 6082⅔ feet per hour.	Wind. Direction.	Wind. Kind.	State of the sea.	Engines. Double strokes of piston per minute.	Steam pressure in boiler above atmosphere in pounds per sq. inch.	Steam cut off at, from commencement of st'k of piston, in inches.	Throttle open.	Vacuum in condenser in in. of mer'y pr. gauge.	Pounds of coal consumed per hour.	Immersion of lower edge of paddles, in feet and inches.	Hull. Mean draft in feet and inches.	Area of immersed amidship section, in sq. ft.	Displacement of sea water, in tons of 2240 pounds.
Oct. 24 to Oct. 26, 1845	72	6·867	Ahead.	Fresh wind.	Rough.	11·300	12·9	38	⅞	26½	3963	5 11	18 9	596·3	2718·9
Oct. 27 to Oct. 28, "	36	7·940	"	Light airs.	Moderate.	13·100	12·9	"	Wide.	"	4824	5 8	18 6	586·3	2663·8
March 24 and 25, 1846	34	7·212	On bow.	Fresh breeze.	"	9·912	10·9	26	"	27½	2666	7 0	19 8	633·0	2920·0
March 27 and 28, "	23	7·335	Abeam.	Light breeze.	Smooth.	10·522	11·6	"	"	"	2633	6 9	19 5	623·0	2865·9
March 31 to April 3, "	84	7·743	Ahead.	Gentle breeze.	"	12·800	13·0	34	Wide	"	4226	5 8	18 6	586·3	2663·8
May 5 to May 9, "	114	6·905	"	" "	Moderate.	10·214	10·4	36	"	"	3072	6 4	19 0	606·3	2774·0
May 10 to May 17, "	48	7·077	Abeam.	Moderate "	"	10·848	9·4	32	¾	"	2652	6 7	19 3	616·3	2829·1
June 1 to June 3, "	58	6·984	"	Gentle "	Smooth.	9·207	14·2	26	Wide.	"	2378	7 0	19 8	633·0	2921·0
June 20 and 21, "	28	6·250	Ahead.	" "	"	9·000	9·5	34	"	"	2500	6 10	19 6	626·3	2884·2
June 27 to July 1, "	44	6·750	Abeam.	" "	"	10·273	12·6	"	"	"	3129	5 9	18 7	589·6	2681·7
October 4 and 5, "	48	7·250	Variable.	Light airs.	"	10·850	11·9	32	"	"	2727	6 10	19 6	626·3	2884·2
November 18 and 19, "	36	7·333	Abeam.	Fresh breeze.	Rough.	10·567	11·8	35	"	"	3102	6 10	19 6	626·3	2884·2
Nov. 24 to Nov. 28, "	100	4·708	On bow	Moderate gale.	Heavy ahead.	8·114	7·9	37	¾	"	2172	5 10	18 8	593·0	2700·5
Dec. 26, '46, to Jan. 12, '47	204	6·396	"	Strong wind.	" "	11·071	9·6	"	"	"	3072	5 8	18 6	586·3	2663·8
March 8 to March 15, "	152	6·746	"	Moderate "	Moderate "	9·000	10·5	32	Wide.	"	3229	6 8	19 4	619·6	2847·5
Oct. 21 to March 13, "	167	7·724	"	Gentle breeze.	Smooth.	11·289	11·9	39	¾	"	2963	5 10	18 8	593·0	2700·5
Means,		6·868				10·486	11·0	35	⅞	27½	3093	5 11	18 9	596·3	2718·9

TABLE II.—Performance of the Mississippi under steam and sails set to topsails, in the Atlantic Ocean and Gulf of Mexico, between March 26, 1846, and October 20, 1847.

Date.	Number of hours.	Speed of vessel in knots of 6082⅔ feet per hour.	Wind. Direction.	Wind. Kind.	State of the sea.	Engines. Double strokes of piston per minute.	Steam pressure in boiler above atmosphere in pounds per sq. inch.	Steam cut off at, from commencement of st'k of piston, in inches.	Throttle open.	Vacuum in condenser in in. of mer'y pr. gauge.	Pounds of coal consumed per hour.	Immersion of lower edge of paddles, in feet and inches.	Hull. Mean draft in feet and inches.	Area of immersed amidship section, in sq. ft.	Displacement of sea water in tons of 2240 pounds.
March 26 and 27, 1846	35	8·030	Abeam.	Moderate.	Moderate.	10·812	11·0	26	Wide.	27½	2658	6 10	19 6	626·3	2884·2
May 10 to May 12, "	27	6·975	"	Gentle.	"	10·268	6·3	36	¼	"	2329	6 10	19 6	626·3	2884·2
May 15 and 16, "	25	7·040	Abaft the beam	Moderate.	"	9·660	6·4	28	3-16	"	1702	6 2	18 10	599·7	2737·2
May 31 and June 1, "	25	7·380	Abeam.	"	Rough.	10·844	13·3	30	Wide.	"	3414	7 0	19 8	633·0	2921·0
June 21 to June 24, "	80	6·341	Abaft the beam	"	Smooth.	8·130	5·6	24	3-16	"	800	7 0	19 8	633·0	2921·0
June 29, "	12	8·500	Abeam.	"	"	11·100	11·1	33	Wide.	"	3540	5 11	18 7	589·6	2681·7
July 1, "	10	8·300	"	"	"	12·300	12·7	33	"	"	2200	5 10	18 6	586·3	2663·8
October 1 to October 3, "	67	7·436	Abaft the beam	"	"	10·494	11·3	32	"	"	2422	7 2	19 10	639·7	2957·4
Nov. 15 to Nov. 24, "	40	8·020	For'd the beam	Fresh.	Rough.	11·110	9·7	35	"	"	2880	6 10	19 6	626·3	2884·2
December 3, "	20	8·000	Aft.	Moderate.	Smooth.	12·500	11·1	33	"	"	3929	7 0	19 8	633·0	2921·0
Dec. 26 to Dec. 31, "	27	7·022	Abeam.	"	Moderate.	9·945	7·3	34	½	"	2395	6 7	19 3	616·3	2829·1
January 10 and 11, 1847	28	8·871	"	"	Rough.	13·107	10·2	26	Wide.	"	3134	6 7	19 3	616·3	2829·1
March 14, "	14	7·145	Abaft the beam	Light.	Smooth.	9·000	8·0	26	3-16	"	1300	6 2	18 10	599·7	2737·2
Oct. 18 to Oct. 20, "	72	7·750	" "	Moderate.	"	9·767	9·4	36	Wide.	"	2647	7 7	20 3	656·3	3049·6
March 16 to March 18, "	48	8·210	Aft.	Fresh.	"	8·900	7·7	30	1-32	"	1721	6 2	18 10	599·7	2737·2
March 19. "	12	9·500	"	"	"	12·500	8·3	30	¾	"	3120	6 0	18 8	593·0	2700·5
Means,		7·574				10·174	9·0	30	11-16	27½	2305	6 10	19 6	626·3	2884·2

TABLE III.—Performance of the Mississippi under steam alone in the Atlantic and Mediterranean, between June, 1849, and November, 1851.

Date.		Number of hours.	Speed of vessel in knots of 6082⅔ feet per hour.	Wind. Direction.	Wind. Kind.	State of the sea.	Engines. Double strokes of piston per minute.	Engines. Steam pressure in boiler above atmosphere in pounds per sq. inch.	Engines. Steam cut off at, from commencement of st'k of piston, in inches.	Engines. Throttle open.	Engines. Vacuum in condenser in in. of mer'y pr. gauge.	Pounds of coal consumed per hour.	Hull. Immersion of lower edge of paddles in feet and inches.		Hull. Mean draft in feet and inches.		Hull. Area of immersed amidship section in sq. ft.	Hull. Displacement of sea water in tons of 2240 pounds.
June 8,	1849	12	7·750	Abeam.	Moderate.	Smooth.	8·667	7·6	35	Wide.	27½	2254	7	11	20	7	669·7	3123·0
June 10,	"	12	8·167	Ahead.	Gentle.	"	9·825	10·5	33	"	"	2361	7	8	19	10	639·7	2957·4
June 18 to June 27,	"	176	8·500	On bow.	"	"	11·860	9·4	33	"	"	2722	5	8	17	10	559·7	2517·1
July 9 to Oct. 23,	"	252	7·405	"	"	"	10·821	10·5	30	"	"	2611	6	10	19	0	606·3	2774·0
Feb. 17 to June 3,	1850	108	7·120	"	"	"	10·760	10·7	20	"	"	2464	6	10	19	0	606·3	2774·0
June 17 and 18,	"	23	7·609	"	Light.	"	10·891	11·1	40	"	"	3068	6	11	19	1	609·6	2794·4
July 28 to Nov. 8,	"	92	7·044	"	"	"	10·206	10·3	28	"	"	2500	6	7	18	9	596·6	2718·9
Feb. 25 to April 13,	1851	48	8·063	Ahead.	Gentle.	"	11·750	11·3	25	"	"	3498	6	2	18	4	579·6	2627·1
April 19 to May 14,	"	160	7·913	"	Light.	"	10·188	10·4	29	"	"	2815	6	4	18	6	586·3	2663·8
May 23 to July 2,	"	233	7·614	On bow.	"	"	11·150	10·1	30	"	"	2816	6	10	19	0	606·3	2774·0
July 3 and 18,	"	36	7·611	Abaft beam.	Gentle.	"	11·444	10·6	32	"	"	3024	5	10	18	0	566·3	2553·8
July 21 to August 20,	"	149	7·846	Forward beam.	Light.	"	10·886	8·3	26	"	"	2645	6	4	18	6	586·3	2663·8
Aug. 29 to Oct. 5,	"	270	7·944	On bow.	Gentle.	"	10·083	9·2	24	"	"	2605	6	8	18	10	599·7	2737·2
October 16 and 17,	"	40	7·550	"	Moderate.	"	9·300	9·8	26	"	"	2460	7	10	20	0	646·3	2994·4
Oct. 19 to Oct. 23,	"	90	6·722	Ahead.	Gentle.	"	8·572	9·1	26	"	"	2290	7	10	20	0	646·3	2994·4
November 1,	"	24	7·500	"	Light.	"	10·509	10·2	26	"	"	2480	6	2	18	4	579·6	2627·1
November 5,	"	24	6·917	On bow.	Moderate.	"	10·317	10·2	27	"	"	3135	5	6	17	8	553·0	2480·4
Means,			7·675	On bow.	Gentle.	Smooth.	10·623	9·8	28	Wide.	27½	2561	6	7	18	9½	598·0	2728·1

TABLE IV.—Performance of the Mississippi under steam and sail set to Topsails, in the Atlantic and Mediterranean, between June, 1849, and November, 1851.

Date.		Number of hours.	Speed of vessel in knots of 6082¾ feet per hour.	Wind. Direction.	Wind. Kind.	State of the sea.	Engines. Double strokes of piston per minute.	Engines. Steam pressure in boiler above atmosphere in lbs. per sq. in. per gauge.	Engines. Steam cut off at, from commencement of st'k of piston in inches.	Engines. Throttle open.	Engines. Vacuum in condenser in in. of mer'y per gauge	Pounds of coal consumed per hour.	Hull. Immersion of lower edge of paddles in feet and inches.	Hull. Mean draft in feet and inches.	Hull. Area of immersed amidship section in sq. ft.	Hull. Displacement of sea water in tons of 2240 pounds.
June 8 and 9,	1849	36	8·017		Moderate.	Moderate.	9·444	9·1	31½	Wide.	27½	2443	7 10	20 6	666·3	3104·7
June 11 and 12,	"	24	8·750	Abeam.	Strong.	Smooth.	9·541	10·7	33	"	"	2371	7 7	20 3	656·3	3049·6
June 26,	1851	8	7·000	Aft.	Moderate.	"	10·450	8·5	30	"	"	2520	6 11	19 1	609·6	2794·4
July 19,	"	24	9·166	Abeam.	"	"	12·604	7·7	36	"	"	3024	5 5	17 7	549·6	2461·2
July 20,	"	24	8·833	On quarter.	Strong.	Moderate.	11·804	7·7	36	"	"	3024	5 3	17 5	543·0	2424·6
August 21,	"	12	8·583	Abeam.	Light.	Smooth.	10·192	9·4	24	"	"	2520	6 0	18 2	573·0	2590·3
October 18,	"	24	9·000	Forward beam.	Strong gale.	Moderate.	10·150	9·1	26	½	"	2261	7 10	20 0	646·3	2994·4
October 26 and 27,	"	48	8·250	Aft.	"	"	11·208	9·0	26	Wide.	"	1925	6 11	19 1	609·6	2794·4
October 28 and 29,	"	48	7·000	Forward beam.	Strong.		8 277	9·1	26	⅛	"	1570	6 10	19 0	606·3	2774·0
Nov. 2 to Nov. 4,	"	60	8·117	"	"	Smooth.	11·233	10·4	24	Wide.	"	2698	5 9	17 1	563·0	2535·2
Nov. 6 to Nov. 9,	"	82	8·573	"	"	"	12·452	9·5	25	"	"	3144	5 3	17 5	543·0	2424·6
Means,			8·302	Strong.	Strong.	Smooth.	10·858	9·4	28	Wide.	27½	2518	6 4	18 7	589·6	2681·7

In the following comparative summary of the vessel's performance, the evaporation obtained from the fuels has been calculated, using Regnault's tables of the latent heat of steam. The initial pressure in the cylinder was obtained from a collacation of many indicator diagrams. The temperature of the feed water entering the boilers is taken at 100° F., the usual average for condensing engines; and the loss by *blowing off* necessary to prevent the deposition of scale, was calculated on the supposition that the sea water was carried at double the natural concentration, or at $\frac{2}{32}$ of the Sewell salinometer used in the Navy, which is the average concentration. The horses power developed by the engines has been calculated from indicator diagrams.

Comparative Summary of the Performance of the Mississippi, deduced from the Means of Tables I, II, III, & IV.

	Table I. Steam alone.	Table II. Steam and sails.	Table III. Steam alone.	Table IV. Steam and sails.
OBSERVED.				
Number of hours performance,	1248	542	1749	390
Speed of vessel per hour in knots of 6082$\frac{2}{3}$ feet,	6·868	7·574	7·675	8·302
Double strokes of piston made per minute,	10·486	10·174	10·623	10·858
Steam pressure in boilers above atmosphere in pounds per square inch,	11·0	9·0	9·8	9·4
Steam pressure in cylinders above atmosphere in pounds per square inch,	9·5	7·2	8·3	7·9
Steam cut off at, from commencement of stroke of piston in inches,	35·	30·	28·	28·
Throttle open,	$\frac{7}{8}$	11-16	Wide.	Wide.
Vacuum in condenser, in inches of mercury,	27$\frac{1}{2}$	27$\frac{1}{2}$	27$\frac{1}{2}$	27$\frac{1}{2}$
Pounds of coal consumed per hour,	3093	2305	2561	2518
Immersion of lower edge of paddles in ft. and in.,	5 11	6 10	6 7	6 4
Mean draft of vessel in feet and inches,	18 9	19 6	18 9$\frac{1}{2}$	18 7
Area of immersed amidship section in sq. feet,	596·3	626·3	598·0	589·6
Displacement of sea water in tons of 2240 lbs.,	2718·9	2884·2	2728·1	2681·7
CALCULATED.				
Mean effective pressure on pistons in pounds per square inch,	17·70	14·00	15·00	14·75
Horses power developed by the engines,	695·73	533·92	597·30	600·34
Slip of the centre of pressure of the paddles in per cents. of their speed,	20·00	9·07	14·82	9·87
Oblique actio.. of the paddles calculated as the squares of the sines of their angles of incidence on the water in per cents,	21·65	25·68	21·64	21·60
Pounds of steam evaporated by one pound of coal from sea water of twice the natural concentration, with temperature of feed water, 100° F., including loss by *blowing off* to keep the sea water at twice the natural concentration,	5·363	5·533	5·133	5·246

An examination of this comparative summary shows in a striking manner the influence of *weather* on the performance of a paddle wheel steamer. Comparing the mean of the results from tables 1 and 3, the vessel being under steam alone, we find the draft of water the same, and consequently the resistance of the hull the same; but in table 1, the engines exerted 695·73 horses power, while in table 3 they exerted only 597·30 horses

power, or 14·15 per centum less, the speed of the vessel in the latter case being greater than in the former case by 0·807 knots, or 11·75 per cent. As a reduced slip of the paddles, necessarily resulting from their deeper immersion in table 3, would to a great extent be balanced by an increased loss of effect from their increased oblique action, the efficiency of the paddle wheels in the two cases may be taken at about the same. The friction of the engines may also be considered about equal, as the number of double strokes of piston were nearly the same per minute.

A recurrence to tables 1 and 3 will show the steaming to have been performed in table 1, both in winter and summer, with strong head winds and rough seas, as an average for half the time; while in table 3, the steaming was performed wholly in the summer, with smooth seas, and but gentle breezes ahead—a difference of weather fully sufficient to cause the difference of speed.

Tables 2 and 4 give the performance of the vessel under steam and sail, during the same periods of time for which tables 1 and 3 give it under steam alone. In the case of table 2, the vessel's draft of water was one foot greater than in the case of table 4; while in the latter instance the horses power developed by the engines was 12·44 per cent. greater than in table 2, but the speed was also greater by 0·728 knots, or 9·61 per cent.

The difference of slip in tables 1 and 2 is 10·93 per cent., and in tables 3 and 4 is 5·95 per cent. The greater difference in the first than in the second case is easily accounted for by referring to the tables, where it will be seen that the wind was much stronger in table 2 than in table 4; also, that the paddles had the greatest immersion.

As has been before stated, tables 2 and 4, giving the performance under steam and sail, show a greater speed than tables 1 and 3, giving the performance under steam alone. These differences are respectively 0·706 knot and 0·627 knot, or an increase of speed of 10·28 and 8·17 per cent. The sails, however, assisted but in a trifling manner in the production of this effect, which is owing almost entirely to the fact of the power of the wind being removed from acting against the vessel, ahead, and either applied abaft the beam, to assist her progress, thus counting twice, by deduction and addition, or being applied abeam, producing a negative effect, and counting only by deduction.

Evaporation by the Boilers.

A reference to the comparative summary shows that the boilers of the *Mississippi* evaporated sensibly the same weight of steam for the same weight of coal, in the performances given in all four tables; the discrepancy being only 0·17 pound of steam, in a mean evaporation of 5·498 pounds of steam per pound of coal, during the performances given in tables 1 and 2; and 0·113 pound of steam per pound of coal, during the performances given in tables 3 and 4, in a mean evaporation of 5·19 pounds of steam per pound of coal. The mean evaporation in all four tables is 5·319 pounds of steam per pound of coal, from which result the maximum differs but 3·86 per cent., and the minimum 5·38 per cent., an amount quite within the ordinary errors of observation. We are, therefore, entitled to conclude that in the boilers of the *Mississippi*, one

pound of Cumberland bituminous coal, which was the kind used during the steaming in tables 1 and 2, produced the same evaporation as one pound of British bituminous coal, which was the kind used during the steaming in tables 3 and 4; consequently, the steam generating qualities of the two coals were equal. This conclusion is also warranted by the similar chemical constitutions of the two coals, which are as follows, on the authority of Prof. W. R. Johnson, for the Cumberland, and the British Admiralty Commission of Playfair and De la Beche, for the British coals:

	Cumberland Bituminous. Average of 5 kinds.	British Bituminous. Average of 6 kinds.
Carbon,	75·05	75·21
Volatile matter,	14·20	14·60
Sulphur,	....	1·39
Ash,	9·49	8·80
Moisture,	1·25	....
	99.99	100·00

INDICATOR DIAGRAMS.—(PLATE III.)

Indicator diagrams Nos. 1 and 2, show about the average performance, corresponding to tables 3 and 4.

Diagram No. 7, shows the similar performance, corresponding to table 1.

Diagrams Nos. 3, 4, 5, and 6, are given to show the effect of *throttling*. They were taken on the passage from Smyrna to Constantinople, February 22, 1850.

When No. 3 was taken, the throttle was *close shut;* steam pressure in boilers 6 pounds per square inch above atmosphere; double strokes of piston per minute, 6.

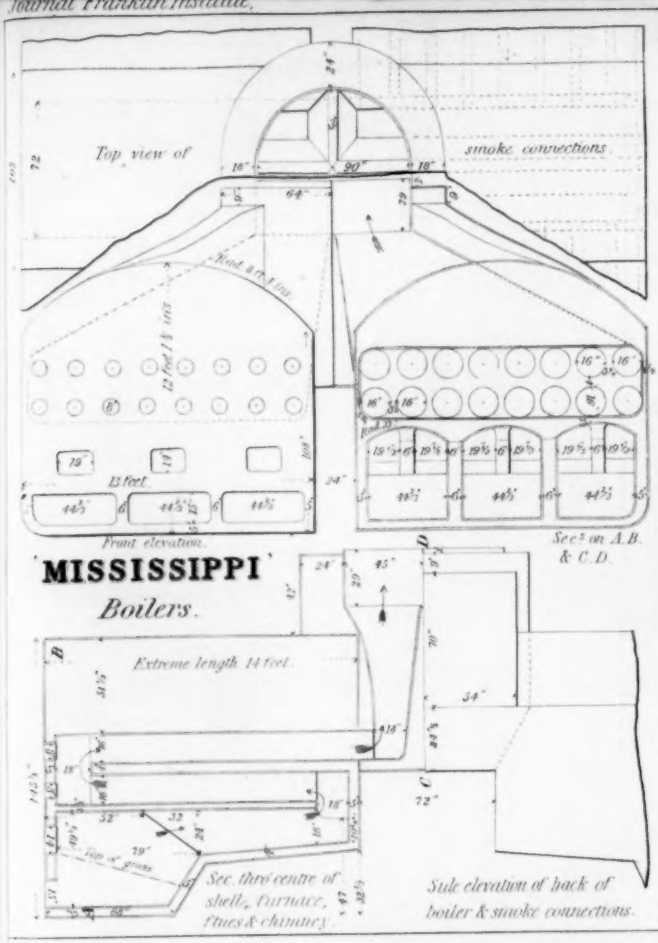
When No. 4 was taken, the throttle was *one-eighth* open; steam pressure in boilers, 5½ pounds per square inch above atmosphere; double strokes of piston per minute, 7.

When No. 5 was taken, the throttle was *one-quarter* open; steam pressure in boilers, 6 pounds per square inch above atmosphere; double strokes of piston per minute, 8½.

When No. 6 was taken, the throttle was *three-eighths* open; steam pressure in boilers, 6 pounds per square inch above atmosphere; double strokes of piston per minute, 9.

Diagrams were continuously taken up to a wide throttle; but after three-eighths open, no further difference was discernible between the boiler and cylinder initial pressures; showing that about half the area of steam valve used was sufficient to pass all the steam required for working the engines at the usual speeds of piston.

Diagrams 8 and 9 are from the *air pumps.* When they were taken, (June 14, 1851,) the vessel was drawing 18 feet 8 inches forward, and 18 feet 5 inches aft. Speed of vessel, 8¼ knots per hour; light wind ahead, and smooth sea; steam pressure in boilers, 12½ pounds per square inch above atmosphere; double strokes of piston per minute, 12; vacuum in condenser, 27¼ inches of mercury; steam cut off in cylinder at 28 inches from commencement of stroke; initial steam pressure in cylinders, 11 pounds per square inch above atmosphere.

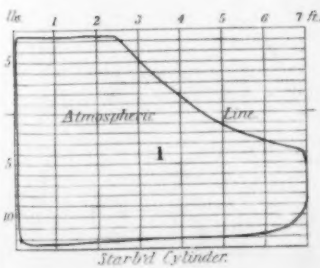

Top view of
smoke connections
Front elevation.
Sec^s on A.B. & C.D.
Extreme length 14 feet.
See thro' centre of shell, furnace, flues & chimney.
Side elevation of back of boiler & smoke connections.

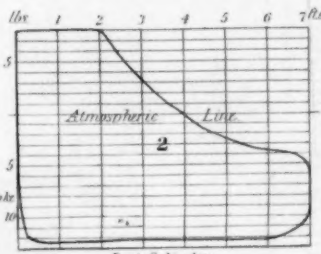
'MISSISSIPPI'

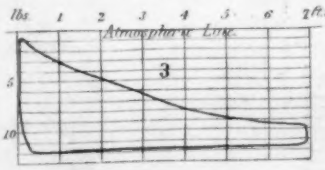
Boilers.

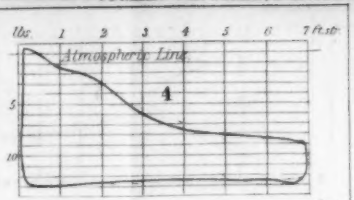
Indicator Diagrams

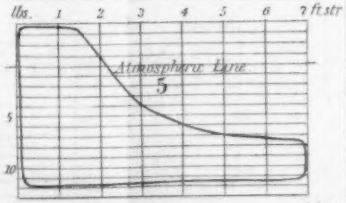
U.S.S. Mississippi.

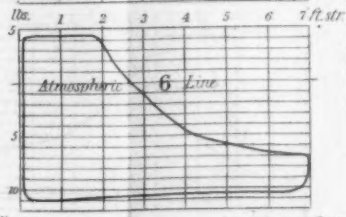


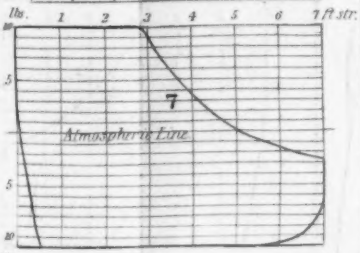


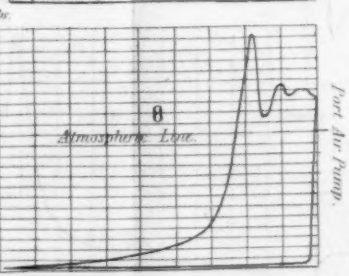


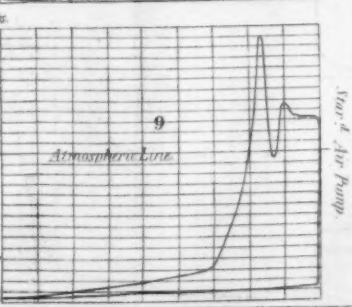












Simultaneously with the air pump diagrams, diagrams were taken from the steam cylinders, and gave a mean effective pressure throughout the stroke of 16·9 pounds per square inch of piston. The mean effective pressure throughout the stroke of the air pump pistons was 5·4 pounds per square inch. The space displacement of both steam cylinder pistons being 429·5 cubic feet, and of both air pump pistons 86·5 cubic feet, and the air pump pistons making but one delivering stroke to each double stroke of the steam pistons, the power required to work the air pump will be $\left(\frac{86{\cdot}5}{429{\cdot}5} \div 2 = 0{\cdot}1014\right.$, and 0·1014 of 5·4 $=\left.\right)$ 0·533 pound per square inch of steam cylinder piston; to this must be added the weight of water lifted by the pump, which by the diagrams appear to have filled about one-ninth the capacity of the pump, or to have been $\left(\frac{86{\cdot}5}{9} =\right)$ 9·61 cubic feet, which multiplied by 64·3 pounds, the weight of a cubic foot of sea water, and divided by 3396·4 square inches, the areas of both pumps, give 0·182 pounds per square inch of air pump piston; reducing this in the same proportion as above for the pistons of the steam cylinders, it becomes 0·018 pound per square inch, which added to the previous 0·533 pound, makes the power absorbed in working the air pumps of the *Mississippi* to be 0·551 pound per square inch of the steam cylinder pistons. This is of course exclusive of the friction of the pumps, an amount which can only be estimated.

Translated for the Journal of the Franklin Institute.

Method of Obtaining Positive Direct Impressions upon Glass. By M. Adolphe Martin.

The simplicity of the employment of the iodized collodion as a sensitive coating, the rapidity with which it receives the luminous impressions, and the delicacy of the picture obtained, have turned all minds towards its exclusive employment. The methods which have been heretofore given refer especially to the obtaining negative pictures, and notwithstanding the remarkable results which have been reached, we cannot but remark the want of harmony and relief of the proofs obtained by these methods.

As I have been employed for some time in this matter, I will soon communicate to the Academy some ameliorations which I have discovered; in the mean time, I think that I shall be rendering a service to photography by communicating a process for obtaining direct positive pictures, as sure as it is easy.

The collodion as I employ it, is composed of an ethereal solution of gun-cotton, (made by heating 2 grammes of pure cotton by 50 grammes of nitrate of potassa and 100 grammes of sulphuric acid; the cotton well washed and well dried is then entirely soluble in a mixture of 10 volumes of ether and 1 volume alcohol;) ether and alcohol are then added, so that the solution is composed of 1 gramme of cotton, 120 grammes ether, and 60 grammes alcohol; there is then added about 1 gramme of nitrate of silver, transformed into iodide and dissolved in 20 grammes alcohol, by means of an alkaline iodide, but iodide of ammonium is preferable.

The plate of glass covered in the ordinary way with a thin coating of this solution, is, before it is dry, plunged into a bath composed of 1 part of distilled water, $\frac{1}{12}$th nitrate of silver, and $\frac{1}{20}$th nitric acid. It is placed in the camera as usual for some seconds. The glass plate is then plunged into a bath of sulphate of protoxide of iron, and then washed with care.

Up to this time the image remains negative; but by plunging it in a bath of the double cyanide of silver and potassium, it becomes positive and complete, if its exposure to the light has been properly managed. There is nothing more to be done than to wash it, coat it with dextrine, and dry it, then frame it in a ground of black velvet.

The bath of cyanides which I use, is the same as that of MM. Ruolz and Elkinton; it is only diluted with about three volumes of water. It is composed of 1 litre of water, 25 grammes cyanide of potassium, and 4 grammes nitrate of silver.

I would remark, in conclusion, that this process always gives me pictures, and that the pictures are always positive. Their perfection only depends on the proper appreciation of the time of exposure.

Ventilating Wind-Guard. Registered for M. A. Suter, *Fenchurch Street, London.**

Our illustration of this last new form of wind-guard so clearly explains its construction, as to render our description almost unnecessary. The barrel, A, terminating the flue, has attached, at a short distance above its open upper end, a flat disk, B, so as to leave an annular discharge aperture for the smoke. In the centre of this disk is a short stud, carrying a universal joint on its top, for the purpose of supporting an adjustable open-topped deflector, or saucer-shaped shield, C, part of which is here broken away to show the joint inside. The figure shows its behavior under the action of a side wind, when it affords a very good shield for the windward side, and a very clear smoke passage on the lee. A great point in this contrivance is the arrangement of the centre joint, which allows the shield to turn with the least breath of wind, and thus afford a constant screen.

Translated for the Journal of the Franklin Institute.

Oxygen from Melted Silver. Extract of a Letter from M. Levol *to* M. Dumas.

As was first observed by Samuel Lucas, pure silver melted in contact with the air absorbs oxygen from it rapidly, and this oxygen is completely disengaged at the moment that the silver becomes solid again. If you desire to extract it during the time that the metal remains fused, you

* From the London Practical Mechanic's Journal, September, 1852.

may do so by means of carbon, which withdraws it by forming carbonic acid; but to separate it in its natural condition appears difficult—nevertheless, it can be accomplished by adding gold in proportion; and in a moment the oxygen is seen to discharge itself so rapidly and so tumultuously as to result in a true effervescence; the matter boils, and rises above the edges of the crucible, even if it be of three or four times the bulk of the melted metals.

Independent of the instruction furnished by this experiment, it furnishes a very curious experiment, and one which a public audience may easily be made to witness.—*Comptes Rendus de l'Academie des Sciences, Paris.*

---

*Gigantic Telescope at Wandsworth Common.**

The construction of a monster reflecting telescope by the Earl of Rosse constituted for a considerable period a prominent topic of interest and conversation in the scientific world. The patience and perseverance of the noble projector under every kind of discouragement, and the unwavering faith with which, at a large outlay to himself, he prosecuted his enterprise to a successful conclusion, secured to him the admiration and esteem of all who took an interest in the higher departments of science, while the discoveries that have since been made through its instrumentality have amply borne out his anticipations and rewarded his exertions. It was necessary, however, that something further should be accomplished. To those not conversant with the subject it may be necessary to state that a reflecting telescope on a large scale must always be a work of exceeding difficulty, and comparatively limited utility. The possibility of constructing an achromatic instrument of a power equal to Lord Rosse's, and through which the object looked at could be directly magnified (as with an opera glass), has long been extremely doubtful; in fact, beyond the reach of mechanical and optical appliances. This desideratum is, however, now on the eve of being supplied.

In the course of a recent ramble on Wandsworth common our attention was attracted by a singularly looking structure, consisting of a plain tower with a long tube slung by its side, surrounded by a wooden boarding to keep off intruders. On making inquiries, we learned that it was a new monster telescope on the achromatic principle in progress of construction, under the superintendence of Mr. W. Gravatt, F. R. S., for the Rev. Mr. Craig, vicar of Leamington. Having obtained an introduction, we inspected the instrument, and ascertained some particulars respecting it which may not be uninteresting. The site, consisting of two acres, has been liberally presented by Earl Spencer in perpetuity, or so long as the telescope shall be maintained. The central tower, consisting of brick, is 64 feet in height, 15 feet in diameter, and weighs 220 tons. Every precaution has been taken in the construction of this building to prevent the slightest vibration; but, if any disappointment in this respect should arise (which, however, Mr. Gravatt does not anticipate), additional weight can be obtained by loading the several floors, and the most perfect steadiness will be thus insured. By the side of this sustaining tower hangs the

* From the London Mechanics' Magazine, August, 1852.

telescope. The length of the main tube, which is shaped somewhat like a cigar, is 96 feet, but with an eye-piece at the narrow end, and a dew-cap at the other; the total length in use will be 85 feet. The design of the dewcap is to prevent obstruction by the condensation of moisture, which takes place during the night, when the instrument is most in use. Its exterior is of bright metal, the interior is painted black. The focal distance will vary from 76 to 85 feet. The tube at its greatest circumference measures 13 feet, and this part is about 24 feet from the object glass. The determination of this point was the result of repeated experiments and minute and careful calculations. It was essential to the object in view that there should not be the slightest vibration in the instrument. Mr. Gravatt, reasoning from analogy, applied the principle of harmonic progression to the perfection of an instrument for extending the range of vision, and thus aiding astronomic research. By his improvements the vibration at one end of the tube is neutralized by that at the other, and the result is that the utmost steadiness and precision is attained. The ironwork of the tube was manufactured by Messrs. Rennie, under the direction of Mr. Gravatt. The object glasses are also of English construction, and throw a curious light upon the manner in which an enlightened commercial policy has reacted upon and promoted the advancement of science. Up to a recent period the flint glass for achromatic telescopes was entirely of foreign manufacture. Since the reduction of the duty great improvements have been made in this department. The making of the large flint glass was intrusted to Mr. Chance, of Birmingham, who at first hesitated to manufacture one larger than 9 inches in diameter. Upon being urged, however, by Mr. Craig, he has succeeded in producing one 24 inches, perfectly clear, and homogeneous in structure. Besides this, there is a second plate glass of the same dimensions, cast by the Thames Plate Glass Company, either of which the observer may use at his option. The manner in which these object glasses are fitted into the tube is a marvel of artistic invention. By means of twelve screws, numbered according to the hours of the day, they can be set in an instant to any angle the observer may require, by his merely calling out the number of the screw to be used. The object glasses also move round in grooves to whatever position it may be considered that a more distinct view can be gained. The tube rests upon a light wooden frame work, with iron wheels attached, and is fitted to a circular iron railway at a distanceof 52 feet from the centre of the tower. The chain by which it is lowered is capable of sustaining a weight of 13 tons, though the weight ofthe tube is only 3. Notwithstanding the immense size of the instrument, the machinery is such that it can move either in azimuth, or up to an altitude of 80 degrees, with as much ease and rapidity as an ordinary telescope, and, from the nature of the mechanical arrangements, with far greater certainty as to results. The slightest force applied to the wheel on the iron rail causes the instrument to move horizontally round the central tower, while a wheel at the right hand of the observer, by a beautiful adaptation of mechanical powers, enables him to elevate or depress the object glass with the greatest precision and facility. So easy, in fact, is the control over the instrument in this respect, that a very slight touch on the wheel lifts 10 cwt. It may be observed, also, that there cannot be the slightest flexure in the

tube; no error or deflexion arising from that cause can occur, while the ease with which it can be directed towards any point of the heavens will enable the observer to make profitable use of any patch of clear sky, however transient it may be. The great value of this need not be pointed to those accustomed to making astronomical observations. With respect to the magnifying power of this novel instrument, it is only necessary to state that, though the focus is not so sharp as it will be shortly, it has already separated the nebulæ in the same way as Lord Rosse's. It has separated some of the double stars in the Great Bear, and shown distinctly a clear distance of 50 or 60 degrees between them, with several other stars occupying the intervening spaces. Ordinary readers will better understand the extraordinary magnifying power of the telescope when we inform them that by it a quarter inch letter can be read at the distance of half a mile.

The preparations for this really national work have been progressing for the last two years under the superintendence of Mr. Gravatt as engineer and mathematician, but is only about three months since the superstructure at Wandsworth common was commenced, and it is already near completion.

We understand that the Observatory is likely to be endowed by its liberal and enlightened creator. It will not only be a lasting monument to his enterprising devotion to science, but an admirable illustration of the perfection to which the mechanical arts have attained in this country.

Lord Rosse has visited the Observatory, and expressed his admiration of this novel and interesting invention.—*Times.*

On the Manufacture of Hydrocarbon Coal Gas from Boghead Coal. By Andrew Fyfe, Esq., M. D., F. R. S. E.*

Continued from page 353.

I come now to consider the question of economy. Assuming that my experiments prove that there is no gain in the amount of light by the combustion of the gas from a ton of Boghead coal by the water process, a question here arises, may not the large quantity of hydrocarbon gas be manufactured at a less expense than the gas from the coal alone? That it may be so per 1000 feet we can easily imagine; but this is not the question to be solved. Gas, like other articles, ought to be paid for according to its value. The more light that 1000 feet will yield when properly consumed, the more ought to be paid for it; of course, the consumer ought to keep this in view, viz., the lower the quality of the gas that he burns, the less ought he to pay for it. I fear that this has not been attended to by those who have so strongly advocated the manufacture of a larger quantity of gas from coal by the addition of other substances, such as the "hydrocarbon" process. I enter upon this part of the subject with diffidence, because I have no satisfactory trials of my own on the results of which I can found calculations. In the trials which I have above recorded, I found that 2 lbs. of charcoal were consumed in the water retort, when 7 lbs. of coal were carbonized in the

* From the London Mechanics' Magazine, July, 1852.

other; and that, to bring out the best results, the quantity of water to be passed through the water retort required to be nearly equal in weight to the coal to be carbonized in the other. Accordingly, for each ton of coal used, it would be necessary to evaporate about a ton of water, and to consume about a quarter of a ton of charcoal, or rather of coke, to produce the requisite quantity of water gas. These would, to a certain extent, show the additional quantity of fuel necessary in the hydrocarbon process. Fortunately, however, there is no necessity for having recourse to calculations founded on these data, and to which, no doubt, objections would be raised. We have statements given of the expense of manufacturing water gas; and, though there is a wide difference between them, I shall take those given by Mr. Clegg in his report, not because I consider them correct, for I think he states the expenditure by far too low, but because they are given by one who advocates strongly the hydrocarbon process, and whose report has been extensively circulated by those who have an interest in it. Surely they will not find fault with me for adopting these statements.

In Mr. Clegg's report it is stated that 1000 feet of Boghead coal cost in the manufacture, including coals at 28s. per ton, labor, lime, fuel, repairs on retorts, &c., 2s. 11½d.—that is, 35d·5. According to Mr. Clegg, water gas, manufactured by the passage of steam over coke, cost 5d. per 1000 feet; and 1000 feet of hydrocarbon gas from Boghead coal, at 28s. per ton, will cost, including the same items, 1s. 0¾d.—that is, 12d·75; 13,500 feet being got from the ton of Boghead when carbonized alone; 52,000 feet from the ton by the water process. The comparative expense, then, of the manufacture of gas per 1000 feet, is as 35·5 to 12·75, or very nearly 3 to 1, when the quantity of hydrocarbon gas stated is got from the ton of coal. Of course, the price per 1000 feet will vary according to the quantity obtained, 5d. per 1000 feet being taken as the price of the pure water gas itself. Were the gases of equal illuminating power, then there would be a very great saving; but, in ascertaining the value of a process of this kind, the value of the gas, not only bulk for bulk, but of the total quantity per ton of coal, must likewise be taken into account. The results of my trials show that each foot of the Boghead gas gives the light of 11·79 candles, consuming 120 grains per hour, while a foot of the Boghead and water gas gives that of only 4·73 candles; consequently, to get the same light from both, for every 1000 feet of the Boghead gas used, we must consume 2490 feet of the hydrocarbon gas, and must pay accordingly for it. The consumer ought to be aware of that, and, consequently, he ought to get his hydrocarbon gas, per 1000 feet, for less than half the price that he pays for the Boghead; otherwise he is a loser by using it instead of the Boghead, or another gas of the same illuminating power as the Boghead. But, again; the important question here occurs, can the manufacturer afford to dispose of his hydrocarbon gas at this lower rate? If the statements that have from time to time been published regarding the hydrocarbon gas be correct, then he ought to do so; but, on further investigation, I fear we must come to a very different conclusion.

Assuming the accuracy of the results of my trials with Boghead, and with Boghead and water together, let us see how the matter stands; and

what I have now to say, applies not only to my own experiments, but likewise to those of Dr. Frankland and Mr. Clegg. The average result of my six trials on the Boghead coal yielded 16,093 feet of gas per ton. Take the coal at 28s. per ton, then

Cost of Coal, - -	28s., or 336d.,	or 20d·87 per	1000 ft.
Manufacture according to Clegg,	143d·775,	or 8d·934	ditto.
Total charge per ton,	479d·775, or 29d·804		ditto.

This gas gave the light of 11·79 candles per foot—that is, 3253·5 lb. sperm per ton; 1000 feet, therefore, equal to 11·790 candles, cost 29d·8.

The average of my eight trials with Boghead and water gave 39,533 feet per ton of coal; then, as before,

Coal and manufacture,	16,093 feet,		479d·775
Water gas, according to Clegg,	23,460 "	at 5d.	177d·3
Total coal and water gas, cost			597d·075, or 15d·09 per 1000 feet.

The gas gave the light of 4·73 candles per foot—that is, 3213·5 lb. sperm per ton; 1000 feet, therefore, equal to 4·730 candles, cost 15d·09. Then,

lb. sperm per ton, Boghead.	lb. sperm per ton Boghead and water.	Cost of coal gas per ton.	Comp. cost of coal gas.
3253·5 :	3213·5 ::	479·77 :	473·87; and 597· : 473·87 :: 100 : 79·3.

Saving in favor of Boghead gas alone = 20·7 per cent. Again,

3213·5 : 3253·5 :: 597 :: 604·4; and 604·4 : 479·77 :: 100 : 79·3.

Saving in favor of Boghead gas alone = 20·7 per cent.

The same results are got by another process. The Boghead gas for 11·790 candles cost 29d·8. The Boghead and water gas for 47·300 cost 15d·09.

Candles per 1000 feet coal gas.	Candles per 1000 feet coal and water gas.	Cost of coal gas.	Comp. value of coal and water gas per 1000. feet.
11·790 :	4730 ::	29·8 :	11·95; and 15·09 : 11·95 :: 100 : 79·1.

Saving in favor of Boghead gas alone = 20·9 per cent.

Candles of water gas.	Candles of coal gas.	Cost of coal gas.	Comp. value of coal gas.
4730 :	11·790 ::	1509 :	37·6; and 29·8 : 37·6 :: 100 :: 79·2.

Saving in favor of Boghead gas alone = 20·8 per cent.

In these calculations the results do not exactly correspond, because I have not thought it necessary to extend the fractions. They are sufficient to show, that according to the results of my trials, in which the quantity of hydrocarbon gas per ton of coal was 39,553 feet of 4·73 candle gas per foot, there is an actual loss by the use of water in the hydrocarbon process to the extent of about 20 per cent.; and this loss is incurred in the manufacture of the gas, independent of other items.

I have next to advert to those instances in which the quantity of hydrocarbon gas per ton of Boghead was greater. When 52,042 feet of gas were obtained, the illuminating power per foot was on an average only

1·99 candles—that is, 238·56 grains of sperm per foot, and 1773·6 lbs. per ton of coal. Then, as before:

1 ton coal, yielding	16,093 ft.	total cost	479d·775
Water gas,	35,950 ft.	do.	179d.752, or 5d. per 1000 feet.
	52,042	do.	659d·527, or 12d·672 per 1000 feet.

One foot of gas was equal to 1·99 candles—that is, 1773·6 lbs. of sperm per ton of coal. Total cost, 659d·527.

One foot of Boghead coal gas, as before, equal light of 11·79 candles—that is, 3253·5 lbs. sperm per ton. Cost, 479d·77. Then

Coal gas = lb. sperm per ton.		Coal and water gas = lb. sperm per ton.		Cost of coal gas.		Comp. value of coal and water gas.
3253·5	:	1773·6	::	479·77	:	261·5; and 659 : 261·5 :: 100 : 39.6.

Saving in favor of Boghead gas only=60·4 per cent.

Coal and water gas =lb. sperm per ton.		Coal gas =lb. sperm per ton.		Cost of coal and water gas.		Comp. value of coal gas.
1773·6	:	3253·5	::	659·5	:	1209·7; and 1209·7 : 479·77 :: 100 : 39·7.

Saving in favor of Boghead gas only=60·3 per cent. Again,

Candles per ft. coal gas.		Candles per ft. water and coal gas.	Cost of 1000 ft. coal gas.	Comp. value of 1000 ft. coal and water gas.
11·79	1·99	29·8	5·03 ; and 12·672 : 5·03 :: 100 :: 39·69.	

Saving in favor of Boghead gas only=60·3 per cent.

Coal and water gas.		Coal gas.		Coal and water gas.		Coal gas.
1·99	:	11·79	::	12·672	:	75·077; and 75·077 : 298 :: 100 : 39·7.

Saving in favor of Boghead gas only=60·3 per cent.

By this mode of operating, the above results show that the coal gas is the cheaper light by upwards of 60 per cent.

That the hydrocarbon process is not economical, is also shown by comparing the lowest results I obtained by Boghead coal alone, with the highest results by the Boghead with water. The two lowest results by Boghead alone yielded, on an average, 2969 lbs., and the two highest by Boghead and water, 3619 lbs. of sperm per ton. Taking the price the same as before, then

2969 : 3619 :: 479·77 : 584·8, and 584·8 : 597 :: 100 : 102:

there is, therefore, an increased expenditure of 2 on the 100 against the water process.

Taking the *lowest* of my results by the Boghead against the *highest* by the Boghead and water, the former is as 2856 lbs. to 3649 lbs. of sperm by the latter. Take the expense for each, the same as before, then,

2856 : 3649 :: 479·77 : 612·98; and 612·98 : 597 :: 100 : 97·3.

Hence, under the most favorable circumstances for the hydrocarbon gas, the same amount of light can be obtained by the usual process from Boghead alone for very nearly the same expense; the difference being only 2·7 per cent. in favor of the hydrocarbon process.

I have next to advert to the trials of Dr. Frankland and Mr. Clegg.

Dr. Frankland obtained from Boghead coal alone 13,240 feet of gas, 1 foot of which was equal to 10·52 candles—that is, 2387·7 lbs. of sperm per ton of coal. From Boghead and water, he got 51,720 feet of 4-candle gas—that is, 3546·5 lbs. of sperm per ton. Taking Mr. Clegg's estimate of the cost of Boghead gas at 35d·5 per 1000 feet when the coal is at 28s. per ton, then the cost of manufacture of 13,240 feet is 470d., which gas yields the light of 2387·7 lbs. of sperm; the cost of hydrocarbon gas from the same coal at the same price, according to Mr. Clegg, is 12d·75 per 1000 feet, and, therefore, 51,720 will cost 659d., which is equal to 3546·5 lbs. of sperm: then—

3546·5 : 659 :: 2387 : 443; and 470 : 443 :: 100 : 94·2.

Therefore, to get the same amount of light, there is a saving on the cost price of the gas of 5·8 per cent. in favor of the hydrocarbon process, according to Mr. Clegg's calculation of the expense. Allowing the accuracy of this statement, it will naturally be asked how it is to be reconciled with that given by Mr. Clegg. In his report, Dr. Frankland alludes merely to the *increase in the quantity of gas* by the hydrocarbon process, and to the consequent *increase in the light* afforded by the combustion of this gas, without reference to expense. Mr. Clegg has, in addition to this, referred to the expenditure of manufacture, and consequent economy of the process. But in this last part of the statement he has made a very important omission. According to him, Boghead coal yields 13,500 feet of gas per ton, while the same quantity of coal affords, by the hydrocarbon process, 52,000 feet of 4-candle gas per foot, the candles burning 120 grains per hour; and he then assumes the saving to be to the enormous extent of 285 per cent. Were this really the case, it ought at once to insure the universal introduction of the hydrocarbon process. In this statement, however, the increase in the *quantity of gas* only is referred to, for—

73,500 : 52,000 :: 100 : 385.

But Mr. Clegg has not taken the *quality* of the gas into account. Had he done so, he should have stated the result very differently.

In his Report, it is said that the data on which his calculations are based are got from practical experiments made, first by Dr. Frankland, and afterwards by himself, with a view to test the accuracy of Dr. Frankland's Report. Though Mr. Clegg has not given the illuminating power of the Boghead coal gas to which he refers; but as he alludes to Dr. Frankland's experiments, which he is endeavoring to verify, we may take the illuminating power given by Dr. Frankland—that is, 10·52 candles per foot.

Taking this, we shall see the result in a very different light. 13,500 feet of Boghead coal gas cost, according to Mr. Clegg, 470d., and yield the light, according to Frankland, of 2431·7 lbs. of sperm; 52,000 feet of Boghead hydrocarbon gas, according to Mr. Clegg, cost 663d., and gave the light of 3565·7 lbs. of sperm; then

3565·7 : 663 :: 2431·7 : 446.

But the Boghead coal gas for this light costs only 470d.; and

470 : 446 :: 100 : 94·8.

Accordingly, to get the same light, the saving in the manufacture is, by Mr. Clegg's own statement, only 5·2 per cent.

Again; Mr. Clegg has stated that Boghead coal per ton will yield, by the water process, not less than 75,000 feet of 2·4-candle gas per foot, and that there is thus *an increase of* 460 *per cent.* This statement, taken in conjunction with others in the Report, is apt to lead to the impression that there is thus a gain by the hydrocarbon process to an enormous extent; we shall find, however, on further investigation that, taking Boghead coal as before, at 28s. per ton, the cost of 1000 feet of the hydrocarbon gas, when 75,000 feet per ton of coal are obtained, is, according to Mr. Clegg, 10d.; thus making the total quantity per ton amount to 787d·5. The gas per foot being equal to 2·4 candles, the light per ton of coal will be 3085 lbs. of sperm. Here, notwithstanding what Mr. Clegg has stated regarding the hydrocarbon process in another part of the Report, that there is an "increase in volume without diminution of light," we find that there is an actual loss on the previous process. 52,000 feet of 4-candle gas are equal to 3565·7 lbs. of sperm; but. 75,000 of 2·4 candle gas are equal to only 3085 lbs.; there is, therefore, a loss of 14 per cent. on the total amount of light.

With regard to the cost, the gas from Boghead coal cost, as before, 470d., and is equal to 2387·7 lbs. sperm. Then

3085 : 787·5 :: 2387·7 : 609.

But the light of 2387·7 lbs., by the Boghead alone, cost only 47d.; and

470 : 609 :: 100 : 129·5.

Accordingly, to get the same light by the hydrocarbon process that we can get by the Boghead alone, there is, by Mr. Clegg's own showing, an increased expenditure of 29·5 on the 100.

In my trials, when 75,253 feet of gas were got from the hydrocarbon process from the ton of coal, the light per foot was only that of 0·27 of candle—that is, 32·4 grains of sperm per foot, or 348·3 lbs. of sperm per ton of coal, at the cost, as before, of; then

Cost.		Cost.				
348·3	: 787·5	:: 3253·5	: 7356; and	479·77	: 7356	:: 100 : 1116.

Here the increased expenditure for the same light is 11·16 times the cost of coal gas alone, showing still further the loss incurred by the water process.

In the trial in which the quantity of hydrocarbon gas per ton was smaller than those above given, a loss is also occasioned. When the gas was 24,932 feet per ton, the illuminating power per foot was 6·52 candles—that is, 78·24 grains of sperm, or 2786·6 lbs. per ton of coal.

	Per ton.	
Cost of Boghead gas, as before,	16,093	479d·77
Water gas,	8,839	44d·19
Total cost,	24,932	523d·96, or 32d·5 per 1000 feet.

Then, 2786·6 : 523·96 :: 3253·5 : 612·1; and 479·77 : 612·1 :: 100 : 125.

The extra expenditure is in this case 25 per cent. for the same amount of light that I get from Boghead alone.

All of these statements still further prove that the hydrocarbon pro-

cess not only is not economical, but, when carried to a great extent, is an expensive one; and it must be kept in remembrance that the above calculations refer solely to the cost of manufacture. There is no allusion to the enlarged gasholders, pipes, &c., necessary for the increased amount of gas that must be supplied to obtain the same light that is got from Boghead gas, and all of which must add materially to the expense.

I have said that there is a wide difference between the statements of Mr. Clegg and others regarding the expense of manufacturing water gas. Mr. Clegg says that it can be made at the cost of 5d. per 1000, which includes expense of materials, labor, tear and wear, &c. In the June number of the *Journal of Gas Lighting*, reference is made to the experiments of Magnier and others, from which it is inferred that the expense will come to 12d. From data given to me by a gas engineer of this place, it would seem to be not less than 10d. If these statements are correct—and I believe that the last-mentioned is below the mark—then the expense of the manufacture of gas by the hydrocarbon process must be far greater than what Mr. Clegg has given it, and, consequently, the loss by the use of water must be still greater than I have stated it to be.

It must, also, be kept in recollection that the expense of manufacturing gas must vary in different places, not only because the cost of materials differs, but likewise because the expense of labor, outlay on tear and wear, according to the extent of the works, is different. In taking the expenditure as given by Mr. Clegg, I have, I think, taken it at a low estimate.

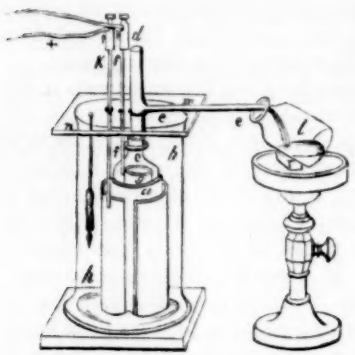
The preceding remarks regarding the hydrocarbon process refer alone to its application to the Boghead coal. I have already said that I preferred that coal to others, because from the large per centage of matter condensable by chlorine which its gas contains, I considered it by far the most likely to be affected beneficially. It was my intention to extend my trials to other coals, had I obtained anything like a saving with the Boghead coal. The results of the trials I have now recorded, render it, in my opinion, quite unnecessary to take up time in trying the process with other coals. I trust that what has been written will be sufficient to prove that there is no economy in the hydrocarbon process, and that, when all things connected with the manufacture and quality of the gas are taken into account, it is a process which ought to be at once abandoned.—*Journal of Gas Lighting.*

Translated for the Journal of the Franklin Institute.

On the Flow of Liquids from the Positive to the Negative Pole of a Closed Galvanic Battery. By M. Wiedemann.

Independent of the magnetic, physiological, heating, and chemical actions, the galvanic current possesses besides, a peculiar force by which it transports materials from the positive to the negative pole. In reference to this, the author undertook a series of experiments, endeavoring to reduce the phenomena to some simple fundamental principle. Of

several different arrangements the following apparatus appears to be the simplest and most suitable:—



Upon a porous earthen cylinder, *a*, closed below, a small tubulated bell glass, *c*, was cemented, into the tubulure of which was introduced a perpendicular tube, *d*, with a lateral discharging tube, *e*. In the earthen cylinder is placed another cylinder of copper or platinum, *g*, with which a wire, *f*, leading to the negative pole of a galvanic battery, is connected. This wire passes through a glass tube carefully cemented to the upper part of the bell. In addition, the earthen cylinder is surrounded by a second cylinder of sheet iron, communicating with the positive pole. The whole apparatus is enclosed in a large glass jar, *h*, which, together with the earthen cylinder of the apparatus, is filled with water or some other liquid. The intensity of the current was measured by a galvanometer. As soon as the current is closed, the liquid rises in the earthen cylinder, and flows out by the discharging tube into a graduated vessel, *i*, placed below it.

By noting the quantity of liquid discharged, and using currents of different forces, the conclusion is, that *the quantities of liquid discharged in a given time are directly proportional to the intensities of the currents.*

When the conducting surface of the earthen cylinder was diminished gradually, by varnishing it, all the other circumstances remaining the same, *the quantity of liquid discharged was independent of the size of the surface.*

In the same time that a current of given intensity caused the discharge of three cubic centimetres of water from the earthen cylinder, the same current developed in the voltameter placed in its current about one cubic centimetre of explosive gas.

Although these laws already explain the general principle of the transporting action of the current, and although it necessarily follows that this action is independent of the particular causes of capillarity and endosmose, nevertheless, all the phenomena which show themselves when a liquid flows through narrow orifices, exercise a peculiar influence on the results above given.

M. Wiedemann consequently sought to find a method of measurement, independent of these phenomena, by annulling the action of their force by a simple hydraulic counter-pressure. The tube placed upon the earthen cylinder of the apparatus was closed on top, and the discharge tube, *e*, was placed in communication with a mercurial gauge. Using different currents and different amounts of cylinder surface, the mercury in the gauge rose to different heights. It results from the measurements, that *the heights to which the liquids under the influence of a galvanic current rise, are directly proportional to the intensity of the current, and inversely as the free surface of the cylinder.*

According to the results of the experiments, the pressures are to the intensities of the currents, in the same ratio as the quantity of liquid discharged by this current in the same time—a result which accords with the laws of the flow of liquid through narrow orifices.—(*Hagen, Poiseuille.*)

By means of the laws above announced, we may establish the transporting action of the galvanic current on the simplest fundamental principles.

Let there be on the two sides of a given section of a certain liquid, two plates immersed at a certain distance from each other, and presenting an electric tension in reference to each other. This section produces in the liquid a current which, if all the circumstances remain the same, is proportional to the tension itself, and to the section of the liquid. Moreover, this current draws the liquid from the positive to the negative pole, with a force equivalent to a hydrostatic pressure directly proportional to the intensity of the current, and inversely as the section of the liquid. It follows directly from the combination of these two conditions, that the force with which the tension subsisting on the two sides of a transverse section of a given liquid, transports that liquid from the positive to the negative side, corresponds to a hydrostatic pressure directly proportional to that tension.

By means of this theorem, we have a simple measure of the electric tension, and of its mechanical action, in terms of the atmospheric pressure and also of the unit of weight. The laws heretofore expressed apply only to liquids of the same nature. When the liquids are different, there is presented, at least in the mechanical action of the current, a difference which is important, and so much greater, because with equal intensities of current, liquids of great resistance transport in the same time a greater quantity of galvanic current than liquids of feeble resistance. Unfortunately, it has not been yet possible to determine the relation which exists between the mechanical action of the galvanic current and the resistance of the liquids which it traverses, on account of the imperfection of the means of appreciating and measuring these resistances. We must, therefore, as yet consider it as an isolated observation, that among the solutions of sulphate of copper of different degrees of concentration, the resistances of which have been recently determined by Mr. Becker, *there passes in the same time through the same earthen well, currents whose quantities are nearly proportional to the squares of the resistances.*

For the Journal of the Franklin Institute.

On the Manufacture of Sugar.

For a few years back, hardly a month has passed that has not brought forth some new process by which we were to obtain a great result at a very small expenditure, and the following article, taken from the London *Morning Chronicle*, will show on several points how much ignorance prevails among those who intend to revolutionize the manufacture of sugar, and to destroy the *molasses* business forever.

"*New Mode of Manufacturing Sugar.*—The new processes are fourfold

in their character, comprising, first, a new mode of obtaining the saccharine juice from the cane; secondly, a new mode of defecating and filtering the juice so obtained; thirdly, the boiling and concentrating of the juice; and fourthly, the crystalization and final curing of the sugar. The varied processes are to be seen at a model sugar house, at the works of Mr. Bessemer, Baxter house, Old St. Pancras Road, London. By the first improvement, in the construction of the cane press, a difference in the yield of the cane is obtained, as compared with the old rolling mill, of about 20 per cent. In the new machine, the pressing tubes are reduced in length from 30 inches to 12, the first four of which are parallel, and three inches wide—the next four inches of their length being taper, and terminating with a width of but 1¼ inch, the smaller contracted point extending as far as the exit end of the tube. By this change of form, the entire removal of the elasticity in the "magas" occupying the tubes is removed, and after the cane has been collapsed by the severe pressure, and its breadth at the same time gradually lessened, every fibre and cell is made to assume new relative positions; not one remains unruptured, and an increased quantity of the juice is consequently expelled at the trough. In addition to this advantage, there is obviously a more equal distribution of power in each revolution of the machine; the deleterious chlorophyl, or coloring matter, of the outer portion of the cane, is not expelled with the juice, as in the ordinary apparatus; the machine may be more easily fed, and weighs considerably less than rolling machines generally in use.

"The juice, when expelled from cane, is unavoidably mixed with numberless minute fragments of cellular tissue, albumen, and other extraneous matters, which, if not speedily removed, tend to produce the acidification of the liquid. At this stage comes in the second of the processes invented by Mr. Bessemer. The present mode of defecation and filtration consists in raising the temperature of the liquor to 150° Fah., when a quantity of lime is thrown in for the purpose of neutralizing the free acid, and assisting in the coagulation of the albumen; the temperature is increased to 180° Fah., when, after allowing time for settling, the scum is removed, and the clear liquor drawn off into the "grand" copper, where it is subjected to boiling heat, when the feculent and other albuminous matters are kept constantly removed from its surface. The more completely these impurities are removed, the greater will be the brightness and value of the finished product. In the new process the juice passes through a wire strainer direct from the spout of the mill into the clarifiers, where it is raised to boiling heat by the application of steam, at which temperature it is kept for about three minutes, by which time the whole of its albuminous constituents and feculent matters will have been coagulated and chemically separated, but will, of course, still remain mechanically mixed, and, in the form of light flock, pervade the entire bulk of the fluid. These substances are then effectually removed, by a process similar to that employed in the manufacture of paper. A drum of about two feet in diameter, and from four to five feet in length, is made to revolve slowly in a small semi-circular tray or vessel. This drum is covered with fine wire cloth, through which the water forces its way, leaving a muddy coating of extraneous matters on the outer side,

which coming in contact as it revolves with a fixed scraper, similar in principle to the "doctor" employed in calico printing, is made to fall off in a state something like dry mud into a receptacle prepared for it. The process is self-acting. It takes in its own supply of foul liquor from an elevated cistern, delivers the clear juice into the evaporating pan, and discharges the refuse as we have already stated.

"Up to this stage the advantages obtained must be evident to all who are acquainted with this interesting branch of manufacture. The liquor being received direct from the press, avoids the necessity of the use of liquor pumps; the clarifiers not being used as subsiding vessels, are not required to be so large; the loss of juice in the removal of the scum, and in the sediment, is prevented; the use of the "mont-jus" is rendered unnecessary; the coagulation of the albuminous matter is more rapidly obtained; the evaporating process may follow immediately after the pressing of the canes; and, finally, the self-cleansing filter performs its work much better than any continuous process of skimming, and renders unnecessary that watchful attendance which is now so imperatively necessary in order to obtain the required brightness and color of the sugar. The saving of manual labor by these improvements is self-evident.

"On the various modes of boiling and concentrating the juice at present in use, whether by a series of semi-globular pans, the vacuum pan, Gadsden's pan, or the apparatus of Mr. Crossley or Mr. Schroder, it is not necessary now to speak, the principle involved in one and all of them being the same—that of evaporating the fluid from the saccharine matter. The inventor of the process now under consideration, contends that, in all the existing arrangements for the separation of the water from the sugar, boiling under any form, or the use of surfaces or pipes heated by steam, must be totally excluded, if the formation of molasses is to be prevented. It is a well established fact, that a thermometer placed in a solution heated by steam or the direct action of fire, furnishes no indication of the temperature to which the liquid is exposed, as a vast amount of latent heat is absorbed by fluids in their formation into steam. To the forgetfulness of this simple fact are to be traced many of the fatal mistakes at present connected with the manufacture of sugar.

"Thus, while the temperature of the syrup during ebullition in a vacuum pan, indicates as low perhaps as 180 degrees Fahrenheit, the copper worm, against which portions of the sugar are constantly brought into contact, is equal to and often above 226 degrees Fah., the consequence of which is the destruction of the color, and an injury to the crystallizing powers of the sugar. By an arrangement which Mr. Bessemer terms a hot air evaporator, the concentration of saccharine fluids may now, however, be effected without the slightest injury to color or quality, and in an increased quantity.

"This apparatus consists of a tank of thin plate iron, of about 10 feet by 8 feet, and 2½ feet in depth, which has a false bottom, curved so as to form two parallel segments of a cylinder. Above these and coincident with them is a hollow drum, of 18 inches in diameter, mounted on an axis, and on which is formed a broad spiral blade in the shape of a screw or "creeper," the thread of which is about fifteen inches in depth, and the convolutions three-quarters of an inch apart: and between each

of the blades or threads of the screw, holes are formed spirally from one end of the drum to the other. At one end of the hollow drum, air, supplied by the blowing fan, and heated to 150 degrees by passing along a flue, is made to enter, which escapes through the holes in the drum in a radial direction, and sweeps like the hot breath of the simoom over the wet surfaces of the various revolving blades, absorbs the moisture thus exposed to its action, and passes off in an invisible vapor.

"Upwards of six thousand square feet of evaporating surface is thus obtained in the small space of 10 feet by 8 feet. The screws make about eight revolutions per minute, and as they revolve, the more concentrated portions of the fluid are washed off as they descend into the fluid, and fresh portions are being constantly brought up on the surface of the screw, to be in like manner subjected to the hot-air blast. Finally, after three or four hours, the whole of the surplus liquor is carried off; the remaining fluid is sufficiently concentrated, and assumes a thick gelatinous appearance; and the screw, made to revolve in the opposite direction, expels the solution from the tank ready for the process of crystallization. By this process the sugar is not at any time exposed to a hotter surface than 140 degrees. No boiling, consequently, takes place, no slea is formed, and not one grain of crystallizable sugar is converted into molasses. The entire cost of fuel for evaporation is saved, the waste heat of the chimney and waste steam of the engine being alone employed, and the apparatus costs less than the ordinary vapor pans; it can be worked with a small amount of wind or water power. Three hogsheads of sugar, it is stated, can be obtained where two only are now produced, whilst the quality will be superior in color and taste, and will be perfectly free from molasses.

"The separation of the crystals from the mother liquor in which they are found is effected in a most ingenious and efficient manner by the use of the air pump. The transformation from the most repulsive and unwholesome-looking black sugar into a fine white sugar is completed in one-seventh of a second by this process. The principle adopted is precisely that employed in 'gassing' lace—an operation resorted to for the purpose of removing the minute filaments of cotton adhering to the surface of the fabric. In the case of the crystals of sugar, a thin film of fluid matter is required to be removed from the surface of the crystal, and this is effected by bringing it in contact with water—a material which would as quickly dissolve the crystal itself, as the flame of the gas would destroy the delicate and fragile web of the bobbin net. How can the water be thus brought into contact with the sugar for such a short period, and in such a manner as only to remove the outer coating of molasses, and leave the crystal uninjured? The process is a very simple one. A table of nine feet in circumference is made to revolve eight times per minute, having a coating of sugar spread over it to the depth of half an inch, and which consequently moves over a space of 72 feet per minute. At one part of its revolution the table is made to pass under a pipe of two inches in diameter, from which a shower of water is falling, and as the pipe is but one-sixth of a foot in diameter, and the table passes it at the rate of 72 feet per minute, it follows that each portion which comes under the

falling water will be retained only $\frac{1}{4}\frac{1}{3}\frac{1}{2}$ of a minute in each revolution. This table being covered with thin brass wire gauze, has placed immediately under it a vacuum chamber, into which the falling water, carrying with it the semi-fluid coating of molasses, is drawn as the table revolves, the crystallized sugar remains on the surface pure and white, and is delivered by a scraper into the hogshead placed for its reception."

Mr. Bessemer, it appears, has a new machine, by which he presses juice from the cane, which acts by a series of compressions at a high velocity, instead of the slow process of rollers. Mr. B., without saying what per centage of the weight of the cane is obtained in juice by other modes of operation, states that *he* obtains 20 per cent. more. On the best estates in the island of Cuba, having sugar mills with great length of rolls and a velocity of $2\frac{1}{2}$ revolutions per minute, (diameter of rolls being from 26 to 30 inches,) 70 per cent. of the weight of cane is obtained in juice; if to this you add 20 per cent. the yield will be 84 per cent., which is considerably more than the cane contains; from 70 per cent. by good management, the product falls off to 50 per cent. by bad.

We are also informed that by the *new process*, the cane juice passes directly from the mill through a wire strainer into the clarifiers. Considering that precisely this process has been in use for at least twelve years, wherever steam trains have been in operation, it is rather a bold declaration to call it new.

Mr. B.'s next improvement is the substituting currents of hot air (for the purpose of evaporation) in the place of steam; to make this necessary, he informs us that while the temperature in a vacuum pan may be as low as 180°, still the copper tubes by which it is heated will show 226°. He is probably only acquainted with the ordinary Howard pan, and is not aware that in this country and Cuba, there are many apparatuses in which the temperature of the sugar in the vacuum pan does not exceed 150°, and the temperature of the steam used is only 212°, being barely of the pressure of the atmosphere; this result is produced by having increased surface for the steam to act upon, and has been in operation several years.

After the peculiar process of evaporation adopted by Mr. B., has been in operation for three or four hours, we are told that the result is a mass of crystals of sugar, not *one grain* having been converted into molasses.

Now, although he states that not one grain has been converted into molasses, still he has given to each grain a covering which he calls mother liquor, (a new name for an old friend,) and this mother liquor he removes by putting the sugar on a circular table of wire having a partial vacuum below it, and as the sugar passes under a fine stream of water, the mother liquor is drawn through into a receptacle below. If this mother liquor and water do not form molasses, what do they form? We should like to know. The only thing new that Mr. B. has produced is, his method of extracting the cane juice, and also of evaporating by means of heated air; and I venture to say that on trial both of them will be found defective.

B.

Translated for the Journal of the Franklin Institute.

New Uses of the Leaf of the Pinus Sylvestris.

Not far from Breslau, in Silesia, in a domain called *la Prairie du Humboldt*, exist two establishments, equally astonishing on account of their objects and of their connexion; one is a manufactory in which the leaves of the pines are converted into a sort of cotton or wool; the other offers to the sick, as a salubrious bath, the waters left from the making of this vegetable wool. Both were founded under the direction of the head Inspector of Forests, M. de Pannewitz, the inventor of a chemical process, by means of which, from the long and slim leaves of the pines is procured a very fine filamentous substance, which has been called *wood-wool* (*laine de bois*), because it curls, felts, and may be spun like common wool.

The *pinus sylvestris*, or wild-pine, whence this new product is procured, is already much esteemed in Germany on account of several valuable advantages which it presents; and in place of abandoning it to its natural growth, extensive plantations of it have been formed, which are true forests. When planted on light and sandy soils, which it prefers, and in which it grows with the greatest rapidity, it gives them consistence and solidity. Associated with the oak, it becomes a shelter, under the shadow of which this latter acquires a great strength of development, until in its turn it rises above its protector. When the pine has reached its fortieth year, it furnishes very profitable crops of rosin. Its wood is esteemed for buildings, &c. The employment which M. de Pannewitz has proposed to give to its leaves, will without doubt contribute to spread still more the culture of a tree already so useful, and will perhaps give it some favor in other countries, where it is scarcely known.

All the acicular leaves of the pines, the firs, and coniferous trees in general, are composed of a bundle of fibres extremely fine and tenacious, which are surrounded and held together by a resinous substance in thin pellicles. When by heat, and by the employment of certain chemical re-agents, the resinous substance is dissolved, it is easy to separate the fibres from each other, to wash them, and to free them from all foreign bodies. According to the method used, the wooly substance acquires a finer quality, or remains in a coarser state; and in the first case it is employed as wadding; in the second, as filling for mattresses. Such in a few words is the account of the discovery due to M. de Pannewitz.

In practice, the *pinus sylvestris* has been preferred to others because it has the longest leaves. There is no reason to doubt that in the countries in which other species of pines exist with equally long foliage, the same product may be as advantageously obtained. There is no danger in stripping the pine of its leaves, even in its youth. This tree has need for its growth only of the whorls of leaves which terminate each branch; all the leaves which surround the rest of the branch may be stripped off without doing any harm. The operation must take place while they are yet green, for it is only then that they can serve for the extraction of the wooly substance. The stripping of the leaves is the province of poor people, and pays them good wages. The operation can only be performed every two years. The product of each gathering is one pound of

leaves for a branch of the thickness of the finger. A beginner can gather thirty pounds per day; an experienced hand may get as much as one hundred and twenty. The profit is greater from a felled tree than one standing.

The first use which was made of this filamentous substance was to substitute it for cotton wadding in quilted coverlets. In the year 1842, the hospital of Vienna bought five hundred of these coverlets, and after using them for several years, renewed its orders. It was remarked among other things, that under the influence of the pine-wool, no kind of parasitic insect harbored in the bed, and the aromatic odor which they emitted was considered to be agreeable and beneficial. Soon afterward, the penitentiary of Vienna was provided with the same kind of coverlets. Since then they have been adopted, as have been also mattresses filled with the same wool, in the hospital *La Charitè* at Berlin, and at the hospital *La Maternitè*, and the soldiers' quarters at Breslau. An experience of five years in these establishments, has shewn that the *wood-wool* is well fitted for use in coverlets, and for wadded goods, and is very durable.

At the end of five years, a mattress of *wood-wool* had cost less than one of straw, which required the addition every year of at least two pounds of fresh straw. Furniture, in the construction of which this matter was used, was preserved from the attacks of moths. It cost three times less than hair, and the most skilful upholsterer could not distinguish an article of furniture in which it is used from a similar one stuffed with hair. We are besides assured that it may be spun and woven. The finest gives a thread resembling that of hemp, and is as strong. When spun, woven, and finished like cloth, it furnishes a product which may be employed for carpets, horse-furniture, &c.; when interwoven with a warp of linen, it may be used as bed-coverings. The products of the manufactories of *Zuckmantel* and *La Prairie du Humboldt*, gained for their present owner, *M. Weiss*, a bronze medal at the exhibition of Berlin, and a silver medal at that of Altenburg.

In the preparation of the *wood-wool*, there is produced an ethereal oil with a sweet odor. This is at first of a green color; exposed to the light, it takes an orange-yellow color; when carried into a dark place, it regains its green color; by rectification, it becomes as colorless as water. It has been shewn to differ from the essence of turpentine which is extracted from the stem of the same tree. Employed in various rheumatic and gouty affections, and applied as a balm upon wounds, it has produced salutary effects; as also in vermicular affections, and in the case of certain cutaneous tumors. When rectified, it answers as an excellent oil in the preparation of the finest lacs which form the base of varnishes, and has been burned in lamps like olive oil; it dissolves caoutchouc completely, and in a short time. The perfumers of Paris use quite a large quantity of it.

It has been found that the liquid residuum which the boiling of the pine-leaves leave, exercises a very salutary action when employed as a bath; so that a bathing establishment has been annexed to the manufactory. This liquid has a greenish color verging on brownish: according to the circumstances and the mode of preparation, it is either gelatinous and

balsamic, or acid; in this latter case prussic acid is produced. During the nine years since the establishment of the baths, their reputation and the number of its visiters have been constantly increasing.

When it is necessary to augment the efficacy of the baths, there is added an extract obtained by the distillation of the ethereal oil of which we have spoken, an extract which also contains prussic acid. The liquid residuum is also concentrated to the consistency of a liquid extract, and then enclosed in sealed vessels, to be used for baths at home.

The membranous substance which is obtained by filtration when the fibre is washed, is put in the form of bricks, and dried; it then serves as a combustible, and produces a large quantity of gas for lighting, which comes from the great quantity of resin which it contains. Henceforth, it may be used for heating and lighting the manufactory.—*Bib. Univ. de Genevi., June*, 1852, *p.* 165.

Hints on the Principles which should regulate the Forms of Ships and Boats; derived from original Experiments. By Mr. William Bland, *of Sittingbourne, Kent.**

Continued from page 316.

Chapter XVI.

The six models just treated of were all with flat bottoms, and this for the sake of convenience. The forms calculated for service must have the curve along the bottom, as shown to be so necessary in Experiments 33 to 36. They must have, likewise, the keel deeper towards and at the stern than towards and at the stem (See Experiment 5); again, the space between the curve along the bottom and the keel must be filled up at both stem and stern; and so constructed as to offer at the bows, from the cutwater to the midship, the least resistance possible to the water; and from the midship to the stern post, to afford the easiest and most direct passage for the water, that it may act to the best advantage against the sides of the rudder.

Upon an inspection of the accompanying diagram, it will be seen that the part cut off the flat bottom by the curve A C E, equals nearly the triangles A B C, and C D E; but since a portion of the triangles will be made up by the sharp bows and body situated between the keel and the line of curvature along the bottom, it will occupy the space of about half the cubic parallelogram: therefore a quarter part only will be necessary to add to the depth at the midship section for the load-line of flotation. Upon testing the above by two models, one with a flat bottom, the other curved and yet left filled up, as required between the curve and the keel, the displacement in the water gave a quarter part as the

* From the London Civil Engineer and Architect's Journal, November, 1851.

exact difference. This proportion of a quarter part to be added to the depth at midship, applies to all the six models, from their similarity in flatness; therefore, the depth at their midship section for the load water-line should be increased by one-quarter part of their draft, when having a flat bottom at midship.

On turning back to those experiments which relate to the depths of keels, commencing with No. 44, it will be seen that the flat bottomed model (No. 2) required no keel; likewise the triangular midship model No. 3; but to the forms Nos. 1 and 4, keels were necessary.

Before deciding upon the midship section best calculated for service, it will be right to criticize those sections which have been already tested. To this end, it will be advisable to review the Experiment 41, where it appears of the triangular model No. 3, that its speed equalled Nos. 2 and 4, the latter having been previously made elliptic. In lateral resistance, No. 3 possessed the same as No. 2, Experiment 54. In stability, No. 3 proved the worst of the four (see Experiment and Table, &c., after No. 43). Lastly, in depth or draft, No. 3 again exceeds all the others. The conclusion to be drawn from the preceding facts are of such a nature as to justify the rejection of the triangular form of midship.

The semicircular form of midship (No. 1), possessed speed as one good quality; but which advantage is counterbalanced, first, by its circular outline being conducive to rolling; next, the depth at which it floats; and third, its deficiency in stability. These evils, it must be admitted, are highly objectionable, and warrant the rejection of the semicircular midship section, except where speed only is sought, when the employment of iron or lead ballast can be had recourse to as a corrective of its instability.

There remains to be considered the flat bottomed model No. 2, and the elliptic one No. 4.

The model 2, (as shown in Experiment 41,) is inferior in speed to No. 1; but as regards all other qualities, so essential to every ship, particularly for burthen, very far the superior,—1st, in floating depth (see Experiment 43); 2d, in not rolling; 3d, in lateral resistance (see Experiment 44); 4th, in stability, the means of speed (see Table, after Experiment 43).

The elliptic midship model (No. 4), as stated in the several experiments before adduced, is equal in speed to No. 2, but is slightly inferior to the same model,—1st, in depth of flotation; 2d, by rolling more; 3d, by having less lateral resistance; 4th, by possessing less stability.

The next point to be considered, before finally deciding upon the midship section, is that part of a ship's midship which is above the load water-line—meaning the sides; whether they should be continued up perpendicularly, or slightly inclined outwards, so as to present at the lee-side a larger bearing on the water, to operate in an increasing ratio against the force of the wind upon the sails.

The Experiment 63, shows that the stability of the model (No. 1) having right-angled sides, equalled the stability of the model No. 2, with its sides inclining outward; and when both were lightened, the influence of the sides which inclined outwards became apparent in the stability remaining unaltered; whereas, in No. 1, the stability was improved to the amount of half-an-ounce; consequently, there appears no

good reason for giving a preference to the beveling-out sides, over those carried up perpendicular.

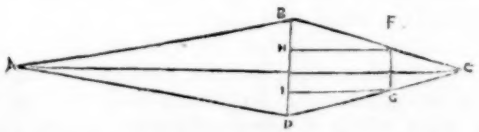
From what has been elicited, it appears that any approach to the triangular midship section has its stability improved materially by ballast, or weight; for, in fact, it is indispensable, since it possesses none without ballast.

Chapter XVII.

The criticism of the four models of midship section being concluded, the inference to be drawn from it is, that (No. 2) the flat bottom, exceeded all the others in the essential qualities for a ship of burthen. But since speed is now become so essential a quality in a ship, those curves must be adopted which have been proved so advantageous in Experiments 33, &c., Chapter VIII.; and in consequence, the flat bottom can only be preserved entire at midships; thus making the addition of a keel absolutely necessary, both before and after that point. No. 4, the elliptic form, comes next. When carrying out the experiments undertaken, with the object of ascertaining the effects of additional weight, for the purpose of gaining an increased depth of flotation in the six models, it came out that a certain few of the models were influenced in their stabilities differently from the others.

The models in question were those which partook of, and approximated in their forms to, the parallelogram and square, and of the oval and circle; and in these the stability increased with the additional weight. On the other hand, the long fish and bird shape models ceased to improve in their stability after a certain amount of weight, they having, as it were, an early limit to any further increase of the same. This peculiar characteristic (and confined almost to the two models Q and R), is of great moment when selecting forms for various purposes; and the cause of the same must be looked for in the narrowness or sharpness of such craft, particularly towards their head and stern.

The Experiment No. 8 and Table C, exhibits No. 2, with one-fifth of the base or beam for the depth of flotation, as possessing the greatest stability. Now, admitting the depth of flotation to be one-fifth at the midship, then the depth from the midship towards both head and stern must be greater than one-fifth; indeed, be in an increasing ratio as the distance nears those extremities; consequently, the stability diminishes proportionally, as shown in the same Table C, in No. 5, being inversely to the length. Thus throwing the support of such parts upon the superior stability about the midship section; which, therefore, must necessarily be reduced. The annexed diagram will explain the meaning.



Let A B C D be the model, and B D the midship section. Take any point in the sides B C and D C, as F, and draw the line F G, parallel to B D; likewise, draw F H, and G I, parallel to A C, cutting B D in H

and I. Now, it is well known, that the straight line F G equals the straight line H I, which is part of the line B D. H I is less than B D; so also must be its equal F G.

From hence it follows, that since B D is greater than F G, then is one-fifth of B D likewise greater than one-fifth of F G; consequently the stability is proportionally less. The same can be shown of every line that may be drawn parallel to B D, between B D and the extremities A and C.

Chapter XVIII.

Presuming thus far as correct, the difficulty then almost vanishes in relation to models or forms of ships for particular services.

To begin with boats intended for speed, and to be impelled forward by the oar. Now, it has been seen in Table No. 1, of the difference in speed between the six models when towed through the water, that the model I proved the swiftest. This model, in its proportion of length to breadth, is seven times the breadth. If greater speed be required, then eight, ten, or more times the breadth may be selected, the midship section being semicircular, and to be situated at the middle of the length (see Experiment 75), or from that to an ellipse; but the utmost care will be requisite to prevent upsetting, from its deficiency in stability.

For a steam vessel upon rivers, and without the aid of sails, seven times the beam or breadth as the length will be found to answer very well, with the midship section semicircular, and at the mid-length (see Experiment 75), or nearly so. Here iron and lead as ballast will greatly improve the stability; but then it will act as an extra load to carry.

When boats and steam-vessels are to have the assistance of sails, the length should be about five times the breadth, as the model O.

For yachts, which are vessels for speed only, and impelled forward by sail, and in consequence great stability required, then the model R, or between R and T, is the one most applicable for the purpose. The floating depth, according to Table 4, must be very shallow, yet the keel with the bottom tapered should be made to descend down into the water sufficient to obtain the requisite lateral resistance, having the lower spaces filled with iron ballast, to further improve the stability for racing purposes; the masts, &c., being made proportionally strong.

Sea fishing boats should closely resemble the model R also, because, although required for burthen rather than speed, great stability is absolutely necessary for the sake of safety, since such craft rarely have decks. Besides this, the cubic capacity of the form R is great, and at little cost, which is a consideration with fishermen. The sides also should be carried up high, both for safety and burthen.

The model Q presents the best form and requisites for the merchant service, which is made evident in Table No. 3. The proportion of its length to breadth is three and a-half the breadth. In the same Table (No. 3), it appears, that when the oblong form of model, as P, is in length five times the beam, and possessing, as is there noted, greater stability than the model O, yet the model O beat P, and with less surface

of sail, which is an advantage as requiring less weight of masts and yards.

Lastly, for ships of war, the model Q is here again pre-eminent for this purpose, particularly for the largest rates; because, in the first place, the stability increases in a degree with the load; and in the second place, of the greater bearing on the water at and towards both head and stern; and in the third, of the almost parallel sides, which afford every facility for the carrying of guns, with space to work them; but draft in the water should on no account be great, because speed is too essential a quality to be dispensed with in a man-of-war.

Chapter XIX.—The Positions of the Centre of Gravity, of the Centre of Lateral Resistance, and the Centre of Force of the Sails.

The position of the centre of gravity in a ship, with regard to its height above the keel, should not exceed when loaded, the line of the surface of the water (see Experiment 8, Table C); otherwise it will lose stability and become top-heavy. If situated much lower than the water-line, the stability will certainly be improved; at the same time, a greater strain than needful will ensue upon the vessel, and thus endanger the breaking of the masts and yards, if they be not of sufficient dimensions to meet it. When the axis of the centre of gravity, considered length-wise of a ship, exactly corresponds with the surface of the water, the rolling will be easy as far as the height of the said gravity is concerned; but the form of the midship section has a very great influence in checking or increasing such motion. The distance from the head and stern in a ship at which the position of the centre of gravity had best be fixed, requires no small degree of reflection, and must be decided before the laying down of the keel, because the circumstance involves both the places of the centre of lateral resistance, and the centre of force of the sails.

The sole fish has the centre of gravity in the widest part of its breadth, and which, therefore, is its centre of motion. The distance of this point from each extremity of the fish is just two-fifths of its length from the head, and three-fifths from the tail; consequently, gives one-fifth as the excess of leverage at the tail over that at the head. In a fish this is most essential, because it derives its power of locomotion chiefly from the rapid, lateral, and curved movements of the tail.

A ship, which is a body impelled forward by sails, could by no means answer if constructed altogether upon the principle of the sole fish; and chiefly on account of the centre of gravity being so forward, as stated. The consequence in practice, from the great distance apart of the centres of gravity and lateral resistance, would be a perpetual conflict against each other for the centre of motion, at the positive disparagement of the speed; for, first, the influence of gravity would place the centre of motion at two-fifths of the length from the cut-water; second, the lateral resistance would operate to carry back the centre of motion towards the centre of length; and third, the centre of the force of the sails, if not situated well a-head by means of a long bowsprit, would be perpetually causing

the ship's head to fly up into the wind. From all that has been stated, it appears in every way impolitic to have the centre of gravity situated too far forward.

In Experiments 73, &c., of the six models, it is shown that their centres of gravity taken in the solid state of the models themselves, previous to their being hollowed out—and, therefore, their true centres being likewise centres of displacement with regard to length—are situated forward and a trifle more than their mid-length. Now, if the centre of lateral resistance be influenced by the head resistance, the two centres, namely, of gravity and lateral resistance, would merely coincide. To accomplish this point, which insures the perfection, in a great measure, of easy sailing and steering vessels, it must be done through attention being given to lateral resistance at the time of making the design, as by well slanting the cut-water, without however losing a good foot-hold, and deepening the keel towards and at the stern—whose post should be perpendicular, for length of keel operates with the best effect in improving lateral resistance, whereas the deepening of it acts to overturn, and thus lessens the resistance (see Chapter XI.),—by this means, the two centres of gravity and lateral resistance will be made to approximate very closely, or quite unite. Nothing now will remain to make perfect the sailing and steering, but to place the centre of the effort of the sails perpendicularly over the two centres before-named. If this be not effected, then whichever way the preponderance of the power of the sails operates, it will, if towards the stern, cause the head to fly up into the wind; and if towards the head, cause it to fly from the wind. The helm, which is the tell-tale, will counteract in part these propensities; likewise the reduction of sail at either stern or head, but that must be at the expense of speed.

If what has been stated be admitted to be correct, the three centres then ought to coincide as nearly as practicable, when the steerage will be easy, and only require the motion of the rudder to overturn the equilibrium to alter the course.

Again, the centre of gravity, though situated correctly as to its height, may yet be extremely injurious to easy motion of pitching and scudding, if the heaviest weights be stowed very fore or aft. Instead of which, they ought to be placed at or near the position of the centre of gravity, the object being the rendering the vibration like a scale-beam, easy and without plunging. To fix the exact plan of stowage is out of the question; but it is best completed at sea, correcting any evils that may be found expedient.

The place of the centre of gravity between the head and stern, is ascertained pretty correctly by the surface of the water coinciding with the load water-line, obtained and laid down from a correct model. But the axis of its height is extremely difficult of detection; and the readiest mode which presents itself would be, the placing of three or more cups or open vessels filled with water, upon separate yet movable shelves, a few inches or more perpendicularly above each other, at the centre of the ship's width and centre of gravity, taken lengthwise. This being done, a lateral rolling motion communicated to the ship artificially, or the taking advantage of a light wind upon smooth water, and observing particularly the surfaces of the water in the cups; then if the water in

any one of them be seen merely to rise up first on one side, afterwards on the other, but in the remaining cups if the motion of the water be more rapid, even to overflowing—that first cup, wherever situated, cannot be far from the axis of lateral motion. Should any doubt on this question arise, just shift the said cup a trifle higher or lower, until the due quietude of its water surface be obtained.

(To be continued.)

Translated for the Journal of the Franklin Institute.

Account of a Diamond, larger than the Regent's, found at Nizam. Extract of a Letter, published by Capt. Fitzgerald, attached to the service of the Nizam.

Thirteen or fourteen years ago, a very large diamond was found in the country of the Nizam. The figure which we give is that of only one part of it: a piece, which had been split off, was finally bought by an Indian broker for 70,000 rupees. The large piece, which is here figured, is now in the possession of the Nizam, and when it was discovered was shown to many Europeans.

The manner of the discovery merits to be reported. This diamond was met, for the first time, in the hands of an Indian child, who was playing with it without any one suspecting its value. Eight *annas* having been offered to the parents of the child, who were poor, the offer aroused their attention, and induced them to inform themselves as to the true value of the stone; and thus it was discovered to be a true diamond, and one of the largest known. The dimensions of the stone, measured exactly on a lead model of it, are as follows:

Length,	2·45 inches.
Exact breadth,	1·35 "
Mean thickness,	0·92 "

The author of this note, having had exact glass models made from those of lead, found their absolute weight 1164·5 grains.

Specific gravity, 3·7 "

The mean specific gravity of the Diamond is 3·52 "

Supposing, therefore, the model accurate, the weight of the diamond is a little less than 1108 grains, or 277 carats for the rough diamond, and so it is generally admitted that rough stones lose one-half their weight in cutting and polishing, there would still remain 138·5 carats; that is an intermediate weight between that of the Regents' (136·75) and that of the diamond of the Grand Duke of Tuscany (139 carats;) if we suppose that the piece split off weighed one-eighth of this weight after cutting, we shall have a weight of 155·5 carets, which would place it between that of the Grand Duke of Tuscany and the large Prussian diamond, (195 carats,) which also came, as is known, from India.

It is not stated whether this stone is also of good water, which can, however, only be known after polishing; but it is known that the Indians, especially those of the Deccan, are very good judges of diamonds; and if it be true, as is reputed, that they paid 7000 rupees for the purchase, it is a favorable augury for the quality of the diamond. In the meantime,

Fig. 1.

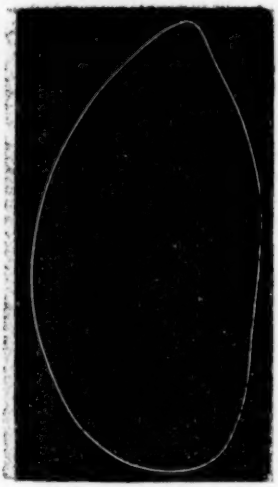
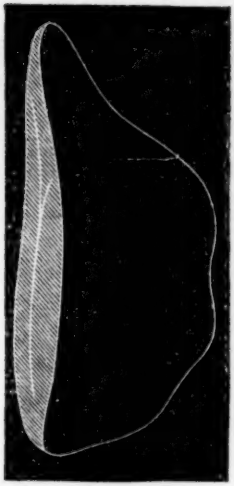


Fig. 2.



if we want an approximate value of the piece alone, which weighs 138·5 carats, as the approximate value of rough diamond is ordinarily obtained in commerce, by squaring their weight in carats and multiplying this number by 50 francs, we shall find for this one the value of 3,836,450 francs ($767,290.)—*L'Institut*, 1852, *p.* 119.

For the Journal of the Franklin Institute.

Dynamical Effect of Falling Bodies.—Results of Experiments made with a view to determine the dynamical effect of bodies falling freely, with the accelerated force due to gravitation.—Read before the Engineers' Institute of New York, Nov. 18, 1852. By Chas. H. Haswell, Esq.

Existing rules regarding the momentum of falling bodies having for a long time failed to satisfy me of their accuracy, I have been led to an investigation of the subject, aided by a series of experiments, which afford very conclusive elements for the construction of the necessary formulæ to apply their results to practice.

The principal instrument used for the purpose of determining the effects was a spiral-spring weigher, which, by the attachment of spring pawls on the sides of it, delicately retained in ratchets, it was retained in its compression; and from an index, sliding over a scale graduated to half pounds, the results were enabled to be accurately registered. The weights were of lead, elongated in their shape; the cords were of hemp,

made up of loose strands, which afforded great flexibility, and the distances were determined from the centres of gravity of the weights.

By this arrangement of pawling the spring, it will readily be recognised that the weights, at their last impacts, were in no wise retarded in their full distance, and as they could not fall beyond it, the full and exact measure of their force was always obtained.

With a view to simplification and facility of comparisons, units of spaces were first decided upon, and the velocities due to them were then determined by the formula $\sqrt{s\,2g}$; s representing the space fallen through, and g, the velocity acquired at the end of the first second, *i e.*, 32·166 feet.

Weight of falling body, in lbs. Avoirdupois.	Space fallen through, in feet.	Velocity acquired at end of fall, in feet per second.	Dynamical effect as indicated by instrument, in lbs.
·5	·5	5·67	12·5
·5	1·	8·02	17·75
·5	2·	11·34	25·
·5	3·	13·89	31·
·5	4·	16·04	36·
·5	5·	17·93	40·
1·	·5	5·67	25·
1·	1.	8·02	35·5
1.	2.	11·34	50·
1·5	·5	5·67	37·
1·5	1·	8·02	53·
2·	·5	5·67	50·
2·	1·	8·02	71·5

With a view to the attainment of all practicable accuracy, the entire experiments were repeated three times, and in each case the weights were made to fall until the limit of impact had been clearly obtained.

An inspection of these results shows, first, *that the dynamical effect or measure of impact, is directly as the velocity acquired;* second, *that one pound falling through a space of one foot, and having a final velocity of* 8·02 *feet per second*, has an impact of 35·5 lbs. From these elements there is readily obtained a formula by which the measure of this force, M, may be correctly arrived at, and which is,

$$M = v \text{ w } 4{\cdot}426.$$

When v = velocity at end of fall in feet per second, and w = weight of falling body in pounds.

Then, to obtain the weight required for a given impact and height of fall, we have by inversion,

$$\frac{M}{v\ 4{\cdot}426} = w.$$

These experiments, however, have not been made with a view to arrive at the ultimate measure of impact of a falling body; as such a result is held to be impracticable of observation, inasmuch as, theoretically it is *infinite*, and experimentally unattainable, without including an expenditure unauthorized by the benefits to be derived from them; as the law determining the effect of falling bodies is sufficiently well understood to render an illustration of this operation unnecessary. My purpose, then,

has simply been, that of giving a measure by which to estimate the effect of a pile driver or any like instrument, wherein the inelasticity and crushing of the materials composing the instrument and the pile itself, are such as to set aside ultimate attainments of impact.

For the Journal of the Franklin Institute.

The Iron Steamer Richard Stockton.

A new iron steamer, the *Richard Stockton*, has recently made her appearance on the Delaware, having been built by Messrs. Harlan & Hollingsworth, of Wilmington, Del., from the designs of Robert L. Stevens, Esq. Her dimensions are as follows:

Length on deck,	270 feet.
Breadth of beam,	30 "
Depth of hold,	10 "
Draft of water,	4 " 2 inches.

Her engine is of the kind known as the *top lever* or river beam form.

Diameter of cylinder,	48 "
Length of stroke,	12 "

Paddle wheels of iron exclusively, and of the kind known in England as the *Morgan wheel*, and but recently introduced into this country.

Diameter of wheel,	22 feet.
Cast iron paddles,	30 inches wide, by 10 feet long.

In this form of wheel, the paddles are attached to the arms of the wheel by journals, on which they vibrate, and by means of eccentric motion they are made to enter and leave the water vertically. Where small wheels are a matter of necessity, or where the steamer has a great variation in her draft of water, the Morgan wheels may be used to advantage; but for our rivers, the common form will be found fully as effective, while the expense of keeping the latter in order is very much in their favor. In addition to this, the Morgan wheel is at least 50 per cent. the heaviest.

The workmanship of both hull and engine is good, and does credit to the builders; while the accommodations for passengers cannot be surpassed, much taste having been exercised in fitting up the cabins and saloons.

In speed, the *Stockton* will not be a *wonder*, judging from her performance on her recent trip to Tacony. With 22 inches of steam, she made but 24 revolutions per minute; while the *Thomas Powell*, on the Baltimore route, having an engine of the same size, can make 24 revolutions of a 28 feet wheel of the common form, and it is well known that the latter is more efficient (equal revolutions and diameters considered) than the Morgan wheel. On inquiry, I found that the *Stockton* was designed to make 30 revolutions per minute, and that the deficiency of 20 per cent. in that respect was principally owing to the boilers, which, although they have sufficient generative power, yet having but a small amount of steam room, they will *foam* or *prime*. This involves the necessity of partially shutting off the engine, and hence a loss of speed.

B.

Translated for the Journal of the Franklin Institute.

On the Density of the Earth. By M. Reich.

In a previous investigation, which has become quite celebrated, M. Reich gave the number 5·45 as expressing the probable mean density of the earth. The immense and memorable researches of Mr. Baily, resulted in the larger number, 5·66. The English astronomer brought to his experiments so much care and so many precautions of all kinds, that M. Reich considered himself beaten. But neither he nor Mr. Baily could explain the much too great difference which existed between the two numbers obtained. After long years of silence and meditation, M. Reich reappears on the arena. Some modifications, and a happy manipulation suggested by Mr. Forbes, have allowed him to repeat his experiments; moreover, a careful study of Mr. Baily's work, has proved to him satisfactorily that the number 5·66 is too large. Without supporting the number 5·45, which is too small, he affirms that the mean density of the earth does not exceed 5·58.—*Poggendorff's Annal. Vol. lxxv., Arch. des Sciences, June,* 1842, *p.* 137.

Remarks.—The same conclusion as to the error in Mr. Baily's result, was pointed out by M. Saigy, in *Revue Scientifique et Industrielle, November,* 1852. He attributes it to a slight error in the value of the moment of inertia of the lever and torsion bar. He calculates the value of the mean density from Baily's experiments, as between 5·47 and 5·55, and asserts 5·5 as the most probable value. This makes the accordance of Cavendish, Reich, and Baily, very satisfactory. M. Saigy also suggests that still greater confidence would be obtained by enclosing every part of the apparatus in exhausted glass tubes, to avoid the effects of atmospheric pressure.—*See Bibl. Univ: de Genève, Vol. xliii., p.* 180.

Ed.

FRANKLIN INSTITUTE.

Proceedings of the Stated Monthly Meeting, November 18, 1852.

Samuel V. Merrick, Esq., President.

Isaac B. Garrigues, Recording Secretary.

The minutes of the last meeting were read and approved.

Communications were read from the Royal Institute, The Royal Geographical Society, and the Institute of Actuaries, London; The Smithsonian Institution, Washington City, D. C., and S. W. Roberts, Esq., Philadelphia.

Donations were received from The Royal Geographical Society, and the Institute of Actuaries, London; The Smithsonian Institution, and Prof. A. D. Bache, Washington City, D. C.; The Baltimore and Ohio Railroad Company, Baltimore, Md.; and Messrs. Solomon W. Roberts, W. H. Wilson, Dr. L. Turnbull, and George M. Conarroe, Philadelphia.

The Periodicals received in exchange for the Journal of the Institute were laid on the table.

The Treasurer's statement of the receipts and payments for the month of October was read.

The Board of Managers and Standing Committees reported their minutes.

The Committee on Exhibitions presented their Report of the recent Exhibition of American Manufactures.

On motion, the following awards of the *Gold Medal* were made, in accordance with the recommendations of the Committee on Exhibitions, in their report presented this evening.

To Day & Newell, of New York, for their Parautoptic Bank Lock.

To Henry H. Stevens, of Webster, Mass., for his manufacture of Linen Sheetings, Diapers, Crash, &c.

To W. H. Horstman & Son, of Philadelphia, Penn., for their manufacture of Fancy Taffeta Bonnet Ribbons.

To W. P. Cresson & Co. of Philadelphia, Penn., for their manufacture of Tinned Hollow Ware.

Resignations of Membership in the Institute (49) were read and accepted.

New candidates for Membership in the Institute (120) were proposed, and the candidates (12) proposed at the last meeting were duly elected.

[The scientific discussions at this meeting are unavoidably omitted.]

COMMITTEE ON SCIENCE AND THE ARTS.

Report on Mr. J. Thomson's Apparatus for Boring Artesian Wells, &c.

The Committee on Science and the Arts, constituted by the Franklin Institute of the State of Pennsylvania, for the promotion of the Mechanic Arts, to whom was referred for examination, an "Improvement on the Machine for Boring Artesian Wells," invented by Mr. John Thomson, of Kensington, Philadelphia, Pennsylvania,—REPORT:

That said machine consists of a cylindrical iron weight, from six to eight feet in length, and from three to four inches in diameter; to the lower end of which a chisel or cutting tool is attached. An iron rod of about one inch square, and having in a portion of its length a twist given to it of from one-fourth to one-half turn per eighteen inches or two feet, is connected with the upper end of the cylindrical weight, by means of a swivel joint. The twisted portion of the rod passes through two small metal disks, one of which, having a square hole, serves as a guide to the rod. These disks are connected together by four elliptical steel springs, intended by their pressure upon the sides of the boring, to retain the guides in their proper position. Shoulders, movable at pleasure, are so placed upon the twisted portion of the rod as to prevent more than about eighteen inches of the latter passing freely through the guides; in doing which, it must necessarily make a part of a revolution, and the operation of raising the weight being comparatively slow, and the friction on the swivel joint considerable, the weight revolves with it; but when allowed

to fall, this latter drops without turning, in consequence of its inertia and of the friction upon the swivel being in a great degree removed.

It is worked in the Chinese manner, by means of a rope attached to the upper end of the rod, and may be made to strike any required number of times in a revolution, by shifting the position of the movable shoulder. This instrument is an improvement on that used in China, and which was introduced into Europe about the year 1828, for the purpose of overcoming certain difficulties attendant upon the ordinary method of boring by rods.

The most important of which are, 1st, The weight of the rods when the boring has attained any great depth. 2d, The time consumed in cleaning the hole, which must be done once for every foot or eighteen inches of depth; the operation sometimes requiring an entire day. 3d, The vibration produced by the great weight and length of the rods, causing them to break in some instances into several pieces. 4th, The bending of the rods, and consequent change of direction in the boring. From these objections the Chinese method is in a great degree exempt. But it has one peculiar to itself, namely, the irregularity in the turning of the chisel; it being necessary, in order to insure its revolution at all, that one man should be constantly employed in turning the rope, while the others work the machine; and this, as may be readily conceived, cannot be attended with altogether satisfactory results. It was to remedy this defect that Mr. Thomson's machine was devised.

The Committee were much pleased with its operation in model, but feared that in practice its revolution would be impeded by the friction against the rock, or by any slight obstruction which might take place, and thus the benefits anticipated from its use be in a great measure destroyed. To overcome this objection on the part of the Committee, Mr. Thomson caused a working machine to be made, and placed it in a well in Mr. Greble's marble yard, where it drilled a distance of thirty feet five inches through a hard gneiss rock; the greatest depth accomplished in one day being six feet and a half, from nine feet to that of fifteen feet six inches.

To test it still further, the Committee met at Mr. Greble's on Monday, 7th instant, when the machine was put up in such a manner as to permit its being examined with the greatest facility. The endeavor was made to prevent its turning, first by pressing the hands on either side of the weight, and then by means of two boards fastened together at one end, and giving a leverage of some three or four feet; but notwithstanding the friction thus produced was so great as to require the utmost exertion on the part of the men to raise it, yet so long as the body causing the friction remained stationary and allowed the weight to ascend, the latter turned with as much certainty and precision as when working freely.

The Committee are, therefore, of the opinion, that their fears above expressed, were groundless, and that the machine is a great and decided improvement on the Chinese method, and that it is superior to any other method within their knowledge. They are also of opinion, that any tendency which may exist in the Chinese instrument to depart from the ver-

tical, is obviated in that of Mr. Thomson, through the weight being always retained by the guides in the axis of the boring.

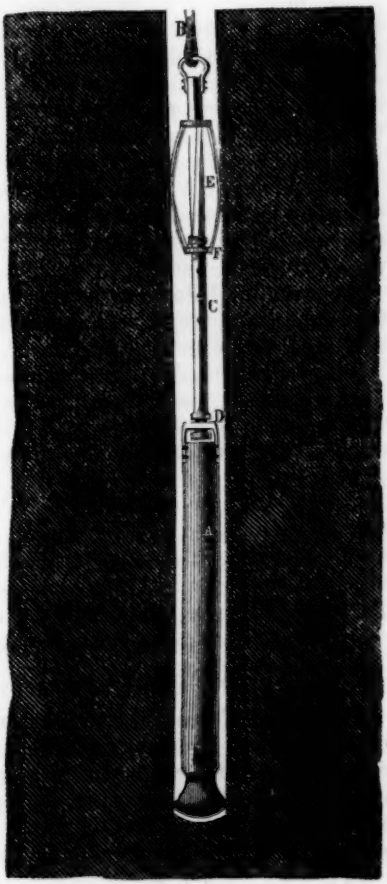
By order of the Committee,

WILLIAM HAMILTON, *Actuary.*

Philadelphia, Sept. 10, 1852.

Description.

A is a cylindrical iron bar, nearly filling the bore-hole, and about five feet long; to the bottom of this is attached the chisel for drilling. On the top of this cylinder at D, is a swivel with a square iron bar about four feet long and one inch diameter, passing through an elliptical steel spring, and fixed to the rope B. The elliptical spring, E, is of four strips, 18 or 20 inches long, and embraces the sides of the bore-hole in the rock, the lower disk of which has a round and the upper a square hole for the bar, C, to work in. It will be observed, that there is a twist of about a quarter turn upon the upper end of the bar, C, and a ring or shoulder, movable at pleasure, is fixed upon this bar, and within the spring, as represented at F. The spring, E, acts as a brace by pressing outwardly, and remains in a fixed position while the machine is at work.



Various methods may be adopted for working this apparatus, either by manual power or otherwise, as all that is necessary is to raise and drop the machine about 18 inches, more or less, by means of the rope from the surface of the ground.

The figure in the engraving represents the machine suspended in the hole in the rock, having been raised a little; its operation is as follows:

The power from the top by pulling the rope lifts the whole, except the spring, E, (the bar, C, merely passing through it;) but as C is a square bar, and the top disk of the spring has a square hole neatly fitting it, and as there is a twist upon that portion of the bar, it follows as a matter of course, that the whole apparatus, except the spring, will turn round a

portion of a circle when rising, agreeable to the twist upon said bar. Having thus raised it 18 inches, the shoulder on C, represented within the spring at F, will be nigh the top of the spring, and the next action is the drop, which must be done in the freest manner, when down comes the weight, A, exactly in the same position in which it was suspended, without in the least following the back course of the twisted bar, which in the drop merely resumed its former position. This straight drop of the heavy weight was obtained from the swivel, D; for although that swivel lifts the weight and bears it round with itself in the rising, it will be observed that there is no weight upon it whilst in the act of falling, as the bar, C, comes down by its own gravity as quick as the bar, A. In raising for the second stroke, the heavy cylinder, A, with the chisel, is swung round another portion of a circle by means of the twisted bar passing through the spring, and being suspended freely in the middle of the bore-hole, the drop is perpendicular, and in the position in which it hung. The spring is gradually carried down as the boring proceeds.

According to the nature of the rock, the chisel will make any number of strokes or cuts for each revolution, by shifting the shoulder, F, to another position upon the bar, C, which allows more or less of the twist to pass through the spring.

To clean the hole or boring, the machine is wound up by the rope to the surface, and the cleaner substituted for the chisel. Any size of hole may be drilled with this instrument, and it will work for a few feet in depth or many hundred feet by simply lengthening the rope.

It is a simple machine, and any good machinist may construct them. The common chisels and cleaner are used, but modified to suit. The cleaning of the whole is done rapidly, as there are no rods to detach, as in rod-boring.

BIBLIOGRAPHICAL NOTICE.

Industrial Drawing, comprising the description and use of Drawing Instruments, the construction of Plane Figures, &c. By D. H. Mahan, &c. &c. New York: John Wiley, 1852. 8vo. pp. 156.

The object of Prof. Mahan in this work, is to explain the method of drawing, as well from models as from diagrams, the use of instruments, &c., in such a manner as to be easily understood by a common workman, and thus to render them intelligent agents in doing things which they now do blindly, and of course badly. Every one who has had occasion to have a machine of any complexity constructed, will appreciate the advantage of such a work, which is intended as a text book for instruction, and is very full as well as very clear and explicit. A chapter on Topographical drawing is affixed. We need scarcely say, what the name of the author will assure most of our readers of, that the work is executed with great ability, and is handsomely presented before the public.

Ed.

INDEX.

LIST OF AMERICAN PATENTS, WITH REMARKS, &c.

May, 1852.		PAGE.
1. Improvements in Rock Drills,	William F. Ash,	7
2. —— Leather Guages,	Lewis W. Beecher,	ib.
3. —— Potato Washers,	Alonzo Bently,	ib.
4. —— Lever Jacks,	Levis H. Davis,	ib.
5. —— Electro-Magnetic Alarm Bells,	Moses G. Farmer,	ib.
6. —— Washing Machines,	Christian Hollingsworth,	8
7. —— Adjustible Wrench,	Andrew Hotchkiss,	ib.
8. —— Differential Safety Valve,	John M'Clintoc,	ib.
9. —— Railroad Car Brake,	Thomas McLaughlin,	ib.
10. —— Anvil,	C. Peters and W. Fetter,	ib.
11. —— Grinding Knives,	James L. Plimpton,	ib.
12. —— Churning Machines,	G. Sandford, assignee of G. A. Meachem,	9
13. —— Tunnels,	Christian Schneider,	ib.
14. —— Grinding, &c., Saw Blades,	William Southwell,	ib.
15. —— Lightning Rods,	James Pratt,	ib.
16. —— Window Blind Machinery,	Daniel H. Thompson,	ib.
17. —— Speaking Tubes,	T. J. Woolcocks and W. Ostrander,	10
18. —— Blind, &c., Fastener,	Samuel Barker,	ib.
19. —— Cot Bedsteads,	William C. Betts,	ib.
20. —— Railroad Car Seats,	Abel B. Buell,	ib.
21. —— Meat Cutters,	William Burns,	11
22. —— Measuring Faucets,	J. R. Byler and G. W. Sensenich,	ib.
23. —— Making Brushes,	Abbott R. Davis,	ib.
24. —— Cooking Boilers,	L. S. DeBibory,	ib.
25. —— Soldering in a Vacuum,	Jos. B. and John R. Horne,	ib.
26. —— Printing Oil Cloths,	James Jenkins,	ib.
27. —— Platform Scales,	Robert Newell,	12
28. —— Lead Pipe Machinery,	Benjamin Tatham,	ib.
29. —— Tables,	Timothy H. Taylor,	ib.
30. —— Gold Beating,	William Vine,	ib.
31. —— Mash Tuns,	R. Wicks and J. Faulker, jr.,	ib.
32. —— Cutting Butter from Firkins,	Nathaniel Woodbury,	13
33. —— Carding,	J. Holmes and E. French,	ib.
34. —— Stoves,	George W. Kenneson,	ib.
35. —— Ships' Blocks,	Charles H. Platt,	ib.
36. —— Umbrellas,	J. V. Tibbetts,	ib.
37. —— Iron Safes,	W. Alfred and Jno. D. Spears,	14
38. —— Saw Sets,	Ashbel G. Batchelder,	ib.
39. —— Straining Saws, in Mills,	Edmond Booth,	ib.
40. —— Cartridges, for Guns,	W. W. Marston and F. Goodell,	ib.
41. —— Swings,	Edward Manward,	15
42. —— Cotton Batting,	E. P. Rider,	ib.
43. —— Churns,	Clarkson Rhodes,	ib.
44. —— Ovens,	Thomas N. Reid,	ib.
45. —— Hay Rakes,	Charles R. Soule,	ib.
46. —— Cements,	B. S. Welch,	ib.
47. —— Making Fuses,	Albert F. Andrews,	ib.
48. —— Locomotive Boilers,	James W. Farrel,	16
49. —— Tumblers of Locks,	Henry Blakely,	ib.
50. —— Watch Chain Swivels,	W. B. Carpenter, ass'd to W. D. Salisby and S. Y. D. Arrowsmith,	ib.

51.	Improvements in Mortising Machines,	John B. Chambers,	16
52.	—— Dressing Stone,	S. W. and R. M. Draper,	ib.
53.	—— Swivel Hooks,	Albert and Morris Falkenau,	17
54.	—— Worm Tubs, for Stills,	George Johnson,	ib.
55.	—— Flour Bolts,	David Marsh,	ib.
56.	—— Lubricating Oils,	William H. Mason,	ib.
57.	—— Homony Machines,	Samuel Hall,	ib.
58.	—— Railroad Cars' Trucks and Brakes,	E. G. Otis,	ib.
59.	—— Cooking Apparatus,	Joseph Smolenski,	18
60.	—— Iron Car Wheels,	Stephen Thurston,	ib.
61.	—— Jointing Staves,	Dennison Woodcock,	ib.

RE-ISSUE.

1.	—— Parti-coloring Yarn,	Alexander Smith,	ib.

DESIGNS.

1.	For Cooking Stoves,	A. Richmond, ass'd to Barstow & Co.,	ib.
2.	—— do. do.,	H. H. Huntly, ass'd to D. D. Woodrow,	19
3.	—— do. do.,	T. H. Herrick, ass'd to L. M. Leonard,	ib.
4.	—— do. do.,	N. S. Vedder and W. L. Sanderson, ass'd to P. J. Clute,	ib.
5.	—— Ladies' Hair Combs,	William Rediffer,	ib.
6.	—— Towel Stand,	do. do.,	ib.

June, 1852.

1.	Improvements in Fountain Pen Holders,	Charles Cleveland,	19
2.	—— Corn Shellers,	David Eldridge,	ib.
3.	—— Railroad Car Wheels,	Nehemiah Hodge,	ib.
4.	—— Copying Manuscript,	John Jones,	20
5.	—— Violins,	William S. Mount,	ib.
6.	—— Revolving Breech Fire Arms,	H. S. North and C. D. Skinner,	ib.
7.	—— Smut Machines,	G. S. Peck,	ib.
8.	—— Power Looms,	Renselaer Reynolds,	ib.
9.	—— Cast Iron Car Wheels,	Daniel R. Rall,	21
10.	—— Fire Escape Ladders,	John C. fr. Salamon,	ib.
11.	—— Looms, for Piled Fabrics,	Robert W. Sievier,	ib.
12.	—— Vertical Trip Hammers,	P. Stebbins and J. Holmes,	ib.
13.	—— Turning and Polishing,	Benjamin J. Taylor,	22
14.	—— Engraving Surfaces,	Isaac Taylor,	ib.
15.	—— Manufacturing Gutta Percha,	John Rider,	ib.
16.	—— Chemical Retorts,	John Akrill,	83
17.	—— Plate and Window Glass,	Terrence Clark,	ib.
18.	—— Preparing Oakum,	John A. and George Cormack,	84
19.	—— Cow Catcher,	Cook Darling,	ib.
20.	—— Cop Spring Frame,	George H. Dodge,	ib.
21.	—— Smoke and Spark Deflector,	Albert Eames,	85
22.	—— Making Spoons, Forks, &c.,	A. Krupp, ass'd to T. Prosser,	ib.
23.	—— Making Axes,	J. Orelup, ass'd to Blood, Goffe & Thomas,	ib.
24.	—— Reflector Lamps,	James H. Pease,	ib.
25.	—— Wheel Cultivator,	Frederick P. Root,	ib.
26.	—— Seed Planters,	James P. Ross,	86
27.	—— Harvesters,	George H. Rugg,	ib.
28.	—— Seed Planters,	Benjamin D. Sanders,	ib.
29.	—— Hay Rakes,	Zenas Sanders,	ib.
30.	—— Soap Boilers,	John R. St. John,	87
31.	—— Rat Traps,	John I. Vedder,	ib.
32.	—— Grease Cocks,	Robert M. Wade,	ib.
33.	—— Fastenings, for Garments,	Elbridge G. Belknap,	ib.
34.	—— Valves or Gates for Paddle Wheels,	Jacob C. Carncross,	ib.
35.	—— Crushing Quartz,	John W. Cochran,	ib.
36.	—— Piano Fortes,	William Compton,	ib.
37.	—— Granular Fuel,	Reuben Daniels,	88
38.	—— Cast Iron Car Wheels,	Peter Dorsch,	ib.
39.	—— Making Cigars,	William Dawson,	ib.
40.	—— Polishing Daguerreotype Plates,	Townsend Duryed,	ib.
41.	—— Alarm Locks,	Charles Fleischel,	ib.

42.	Improvements in Preparing Yarn for Duck and other fabrics,	Horatio N. Gambrill,	88
43.	—— Organs,	Albert and George Gemunder,	89
44.	—— Carriage Axles,	Kingston Goddard,	ib.
45.	—— Lay in Looms,	John Goulding,	ib.
46.	—— Derricks,	Selah Hill and C. H. Dupuy, jr.,	ib.
47.	—— Preparations of Archil,	Leon Jarossen,	ib.
48.	—— Jointing Staves,	E. Jenny and D. Rood,	90
49.	—— Saddles,	William S. Kennedy,	ib.
50.	—— Wiring Blind Rods,	Frederick H. Moore,	ib.
51.	—— Hanging Mill Spindles,	William H. Naracon,	ib.
52.	—— Bedstead Fastenings,	Adam S. Newhouse,	91
53.	—— Meat Cutters,	Joseph Potts,	ib.
54.	—— Ore Stampers,	Thomas Reaney,	ib.
55.	—— Hand Seed Planters,	Gelston Sanford,	ib.
56.	—— Harvesters,	W. and T. Schnebly,	ib.
57.	—— Label Cards,	James Sharp,	ib.
58.	—— Making Cordage,	D. Perry, ass'd to F. & J. W. Slaughter,	ib.
59.	—— Sewing Machines,	A. B. Wilson, ass'd to Wheeler, Wilson, & Warren and Woodruff,	92
60.	—— Stamping Ores,	Virgil Woodcock,	ib.
61.	—— Friction Clutch,	Wendel Wright,	ib.
62.	—— Detaching Harness from Horses,	George Yellott,	ib.
63.	—— Washing and amalgamating Gold,	Alexander Barclay,	93
64.	—— Valves for Pumps,	Joel R. Bassett,	ib.
65.	—— Bomb Lance for Whales,	Christopher C. Brand,	ib.
66.	—— Heat Radiator,	Merrill Colvin,	ib.
67.	—— Horse Power,	Aaron D. Crane,	ib.
68.	—— Dumping Wagon,	Abraham V. Cross,	94
69.	—— Making Wrought Nails,	Daniel Dodge,	ib.
70.	—— Sewing Machines,	W. O. Grover and W. E. Barker,	95
71.	—— Foot Car,	Nehemiah Hodge,	ib.
72.	—— Clover Harvesters,	John Krauser,	ib.
73.	—— Railroad Car Axles,	William S. Loughborough,	ib.
74.	—— Steps, &c., in Mill Spindles,	Theodore S. Minniss,	ib.
75.	—— Planing Machines,	Nicholas G. Norcross,	96
76.	—— Preparing Flocks,	John R. Peters,	ib.
77.	—— Fluid Metres, &c.,	William H. Lindsay,	ib.
78.	—— Ploughs,	David Swartz,	ib.
79.	—— Time Pieces,	S. R. Wilmot,	97
80.	—— Imitation of Stone,	Charles Iles,	ib.
81.	—— Mill Stone Dress,	Wilson Ager,	ib.
82.	—— Hulling Buckwheat,	do. do.,	ib.
83.	—— Sail Hank,	Samuel Barker,	ib.
84.	—— Propelling Vessels,	Matthew A. Crooker,	ib.
85.	—— Revolving Last Holder,	Henry C. De Witt,	98
86.	—— Railroad Car Trucks,	Caleb R. Disbrow,	ib.
87.	—— Potato Diggers & Stone Gatherers,	John T. Foster,	ib.
88.	—— Lock,	Francis Garachon,	ib.
89.	—— Steps of Mill Spindles,	Gideon Hotchkiss,	ib.
90.	—— Bedstead Fastenings,	Jasper Johnson,	ib.
91.	—— Moulding Hollow Ware,	James J. Johnson,	99
92.	—— Heating Sheet Iron,	Henry M'Carty,	ib.
93.	—— Compound Anchor,	Samuel Nye,	ib.
94.	—— Mixing Mortar,	Jesse Peck,	ib.
95.	—— Locomotive Engines,	H. R. Remsen and P. M. Hutton,	ib.
96.	—— Skates,	Nathaniel C. Sandford,	ib.
97.	—— Belt Clasp,	Albert M. Smith,	100
98.	—— Ringing Bells,	Thomas V. Stran,	ib.
99.	—— Brick Machines,	R. A. Ver Valen,	ib.
100.	—— Sofa Bedsteads,	Alfred Walker,	ib.
101.	—— Railroad Cars,	Charles Waterbury,	ib.
102.	—— Connecting Cocks with Pipes,	Daniel A. Webster,	ib.

103. Improvements in Sugar Boiling,	J. Ramos, ass'd to Gallagher & Tirado,	101
104.—— do. do., . .	do. do. do. do.,	ib.
105.—— Revolving Boot Heels,	T. Walker, assigned to B. B. Thayer, ass'd to Churchill & Baxter,	ib.

RE-ISSUES.

1. Improvements in Cutting Paper and Trimming Books, .	Frederick J. Austin, .	101
2. —— Batting of Cotton, &c., .	H. B. & H. T. Lawton, .	ib.

DESIGNS.

1. For Portable Grate, . .	D. Thompson, ass'd N. Market Iron F'dy,	102
2. —— Parlor Stove, . .	Samuel D. Vose,	ib.
3. —— Coal Stove, . .		
4. —— Box Stove, . .		
5. —— Parlor Cook Stove, .		
6. —— Dining Room Stove, .	W. L. Sanderson, ass'd to R. & R. Finch,	ib.
7. —— Cooking Stove, . .	S. Gibbs, ass'd to North, Harrison & Co.,	ib.
8. —— do. do., .	J. H. Conklin, ass'd to R. & R. Finch,	ib.

July, 1852.

1. Improvements in finding Centre of Circle,	Nathan Ames, . .	161
2. —— Construction of Bridges, .	A. Bradway and E. Valentine,	ib.
3. —— Car Seats, . .	John Briggs,, . .	ib.
4. —— Turning Engines, . .	James S. Brown, . .	ib.
5. —— Construction of Bridges,	J. B. Gridley, .	ib.
6. —— Hand Planes, . .	Birdsill Holly, .	ib.
7. —— Patterns for Metal Hubs, &c.,	Jasper Johnson, . .	162
8. —— Portable Grist Mills, .	Charles Leavitt, .	ib.
9. —— Churns, . . .	Norman B. Livingston, .	ib.
10. —— Railroad Car Brakes, .	William Montgomery, .	ib.
11. —— Defecating Sugar, . .	Robert and John Oakland, .	ib.
12. —— Cutter Heads for Planing,	J. M. Patton and W. F. Fergus,	ib.
13. —— Cordage Machines, .	John W. Peer, .	ib.
14. —— Double-Acting Doors, .	William Reppon, . .	163
15. —— Grinding Puppet Valves,	Enos Rogers, .	ib.
16. —— Rubbing Stone, . .	P. E. Royse and J. Reynolds, .	ib.
17. —— Cutters for Wood Screws,	Thomas J. Sloan, .	ib.
18. —— Thermostat for Regulating Heat,	do. do., . .	ib.
19. —— Pneumatic Spring, .	Elijah Ware, .	ib.
20. —— Planing Machines, .	William Watson, . .	164
21. —— Railroad Car Brakes,	L. F. Thompson & A. G. Batchelder, assigned to H. Tanner, .	ib.
22. —— Screw Threading, .	C. Whipple, ass'd to N. E. Screw Co.,	ib.
23. —— Tonguing Boards, . .	Samuel Albro, . .	ib.
24. —— Driving Nails, .	Seth P. Carpenter, .	ib.
25. —— Cast Iron Caissons, .	James P. Duffy, . .	165
26. —— Threshing Machines, .	Joseph G. Gilbert, .	ib.
27. —— Shingle Machines, .	Furman Hand, jr., . .	ib.
28. —— Railroad Car Brakes, .	Joseph P. Martin, .	ib.
29. —— Churns, . .	John McLaughlin, .	ib.
30. —— Shingle Machines, . .	Robert L. Noblet, .	ib.
31. —— Benzole Light, .	Henry M. Paine, . .	166
32. —— Corn Sheller, . .	William Reading, .	ib.
33. —— Cast Iron Car Wheels, .	Hiram H. Scoville, .	ib.
34. —— Bedstead Fastenings, .	Isaac A. Sergeant, .	ib.
35. —— Alarm Clocks, .	Jonathan S. Turner, .	ib.
36. —— Cotton Presses, . .	Jacob G. Winner, . .	ib.
37. —— Seed Planters, .	Joshua Woodward, .	167
38. —— Door Locks, . .	M. R. Stephenson, ass'd to E. Holman,	ib.
39. —— Fire Engines, .	Orville G. Adkins, .	ib.
40. —— Car Seats, . .	William S. Bass, . .	ib.
41. —— Ploughs, . .	Neri Blatchly, .	ib.
42. —— Shaving Shingles, . .	Abel Bradway, . .	ib.
43. —— Converting Rotary into Rectilinear Motion, . .	Alfred Carson, . .	ib.

44.	Improvements in Dressing Stones,	R. Eastman, ass'd to S. Eastman,	167
45.	—— Cruppers for Harness,	John J. Flack,	168
46.	—— Grain and Grass Harvesters,	Eliakim B. Forbush,	ib.
47.	—— Railroad Car Brakes,	William Hall,	ib.
48.	—— Rice Hullers,	Clark Jacobs,	ib.
49.	—— Grass Harvesters,	Jesse S. and David Lake,	ib.
50.	—— do. do.,	William Manning,	ib.
51.	—— Sewing Machines,	Charles Miller,	169
52.	—— Grain Separators,	Cyrus Roberts,	ib.
53.	—— Railroad Car Brakes,	J. Houston and E. Ross,	ib.
54.	—— Rubbing Stone,	Pleasant E. Royse,	ib.
55.	—— Water Pipes of Tuyeres,	Peter Sweeny,	170
56.	—— Railroad Car Coupling,	James Turner,	ib.
57.	—— Preparing Zinc,	Henry W. Adams,	ib.
58.	—— Forming Button Backs,	James C. Cooke,	ib.
59.	—— Saws for Sawing Stone,	Albert Eames,	ib.
60.	—— Churn and Butter Worker,	Orsamus R. Fisler,	ib.
61.	—— Fastenings for Harness,	Thomas Henderson,	171
62.	—— Duplex Escapements,	Charles E. Jacot,	ib.
63.	—— Seed Planters,	Adam Kraber,	ib.
64.	—— Soaps,	William M'Cord,	ib.
65.	—— Railroad Track Clearer,	Simeon Minkler,	ib.
66.	—— Blocks for Stretching Coats,	Samuel M. Perkins,	ib.
67.	—— Railroad Car Seats,	Samuel M. Perry,	172
68.	—— Mortising Machines,	William C. Shaw,	ib.
69.	—— Lamps,	Charles Siedhof,	ib.
70.	—— Cutter for Cloth, &c.,	Halsey D. Walcott,	ib.
71.	—— Uniting Steel and Iron,	B. C. Leavitt, ass'd to Bishop & Libby,	ib.
72.	—— Brooms,	C. T. Moore, ass'd to F. S. Noyse,	ib.

RE-ISSUES.

1.	Improvements in Bedsteads.,	Nathaniel Colver,	173
2.	—— Tonguing Boards,	R. Crossby, jr., ass'd to H. D. Edgecomb,	ib.

DESIGNS.

1.	For Parlor Stove,	J. D. Green, ass'd to Morrison & Tibbets,	173
2.	—— Cooking Stove,	W. F. Pratt and G. W. Bosworth,	ib.
3.	—— do. do.,	Samuel D. Vose,	ib.
4.	—— Hat and Umbrella Stand,	C. Zeuner, ass'd to Greenwood & Co.,	ib.
5.	—— Portable Grate,	A. Richmond, ass'd to Barstow & Co.,	174
6.	—— Parlor Stove Plates,	Amos Paul,	ib.
7.	—— Plates of Cooking Stove,	Dutee Arnold,	ib.
8.	—— Medallion of D. Webster,	Peter Stephenson,	ib.

ADDITIONAL IMPROVEMENTS.

1.	Improvements in Mashing Maize,	Frederick Seetz,	174
2.	—— Metallic Heddles,	Jacob Senneff,	ib.

August, 1852.

1.	Improvement in Railroad Car Seats,	Charles P. Bailey,	174
2.	—— Weaving Figured Fabrics,	Cornelius W. Blanchard,	ib.
3.	—— Pressure Gauges,	Eugene Bourden,	175
4.	—— Dumping Wagons,	Thomas Castor,	ib.
5.	—— Talley Boards,	Francis N. Clark,	ib.
6.	—— Casting Stereotype Plates,	Hobart P. Cook,	ib.
7.	—— Preserving Butter,	Louis D. Corn,	ib.
8.	—— Weaving Figured Fabrics,	Samuel and James Eccles,	176
9.	—— Screw Cutting Stocks,	Mitchell C. Gardner,	ib.
10.	—— Scales for Weighing,	W. P. Goolman & W. Haltsechaw,	ib.
11.	—— Jaquard Looms,	John Goulding,	ib.
12.	—— Ox Yokes,	Ezra Hough,	177
13.	—— Elastic Horse Shoe,	John O. Jones,	ib.
14.	—— Scythe Fastenings,	Alpheus Kimball,	ib.
15.	—— Making Illuminating Gas,	Henry W. Adams,	235
16.	—— Double Gates,	J. S. Brown,	ib.
17.	—— Casting Type,	W. P. Barr, assigned to G. Bruce,	ib.
18.	—— Cider Mills,	Jarvis Cote,	ib.

19.	Improvement in Drilling Stones,	H. W. Catlin, adminis'r to A. Catlin,	235
20.	—— Railroad Frogs,	M. Curtis and E. St. John,	ib.
21.	—— Tanning,	A. K. Eaton,	ib.
22.	—— Grain and Grass Harvesters,	D. Fitzgerald and J. H. Smith,	236
23.	—— Carriages,	Jonathan Fox,	ib
24.	—— Glass Lenses,	John L. Gilliland,	ib.
25.	—— Converting Reciprocating into Circular Motion,	Charles Howard,	ib.
26.	—— Drying Sized Paper,	J. Kingsland, jr., and N. White,	ib.
27.	—— Reducing Gold Minerals,	William Longmaid,	ib.
28.	—— Weaving Piled Fabrics,	Samuel Richardson,	ib.
29.	—— Railroad Car Brakes,	John Schoenherr,	237
30.	—— Hats,	Benjamin Sherwood,	ib.
31.	—— Threading Wood Screws,	Cullen Whipple,	ib.
32.	—— Mill Dress,	John W. Kane,	ib.
33.	—— Ventilators,	Mortimer M. Camp,	ib.
34.	—— File Cutting Machinery,	J. W. Conkling, H. L. Sedman, and E. Wentner,	238
35.	—— Wrought Iron Railroad Chairs,	Robert Griffiths,	ib
36.	—— Spark Arrester,	J. Leeds, G. H. and A. A. Oat, assigned to J. Leeds,	ib
37.	—— Cotton Presses,	Lewis Lewis,	ib
38.	—— Hernia Truss,	A. J. Lownsberry,	ib.
39.	—— Artificial Legs,	B. Franklin Palmer,	239
40.	—— Neck Yoke of Horses,	Calvin L. Rawdon,	ib.
41.	—— Artificial Legs,	Jonathan Russell,	ib.
42.	—— Bedstead Fastenings,	William Shaw,	ib.
43.	—— Hot Air Furnaces,	George S. G. Spence,	ib.
44.	—— Forming Hat Bodies,	Thomas Walber,	ib.
45.	—— Colorifers,	Samuel Whitemarsh,	240
46.	—— Curriers' Beam and Knife,	James D. Willoughby,	ib.
47.	—— Making Paints,	W. F. Davis, ass'd to B. Cornell,	ib.
48.	—— Fastening Bolts to Braces,	E. Smith, ass'd to D. Maydole,	ib.
49.	—— Manufacturing Cord Buttons,	N. Perkins, ass'd to S. Dow,	ib.
50.	—— Bill Registers,	J. N. Ayres,	ib.
51.	—— Cooking Stoves,	Reuben J. Blanchard,	241
52.	—— Lasting Boots,	Hezekiah Conant,	ib.
53.	—— Cutting Cheese,	Walter K. Foster,	ib.
54.	—— Bed for Invalids,	Stephen D. Hopkins,	ib.
55.	—— Lasting Boots,	Benjamin Livermore,	ib.
56.	—— Signal Telegraphs,	Charles Latimer,	ib.
57.	—— Churns,	Rufus Maxwell,	242
58.	—— Rotary Engines,	Cassius A. Mills,	ib.
59.	—— Cutting Hand Rails,	George P. Pullinger,	ib.
60.	—— Horse Power,	David Russell,	ib.
61.	—— Griping Wood Screw Blanks,	Thomas J. Sloan,	ib.
62.	—— Threading Pointed Wood Screws,	Do. do.	ib.
63.	—— Railroad Truck,	Edwin Stanley,	ib.
64.	—— Feeding Boilers,	Andrew Walker, jr.,	243
65.	—— Mashing Vegetables and Mixing Clay,	Clark Alvord,	ib.
66.	—— Reverberatory Furnaces,	Christopher G. Best,	ib.
67.	—— Wash Board,	Lester Butler,	ib.
68.	—— Roller Saw Set,	A. Bradway and E. Valentine,	ib.
69.	—— Kilns for Pottery,	George R. Booth,	ib.
70.	—— Blind Operator and Fastener,	James R. Creighton,	ib.
71.	—— Artificial Legs,	John S. Drake,	244
72.	—— Oil Cans,	S. Field and C. W. Heald,	ib.
73.	—— Printing Press,	George P. Gordon,	ib.
74.	—— Washing Machines,	Jarvis T. Mudges,	ib.
75.	—— Steam Engine Governor,	G. S. Stearns and W. Hodgson	ib
76.	—— Restoring Shape and Tempering Articles of Hardened Steel,	John Silvester,	ib.

77.	Improvement in Brick Machines, .	A. Woodworth and S. Mower, .	245
78.	—— Metallic Stuffing Box Packing in Steam Engines, .	Ebenezer Winship, .	ib.
79.	—— Electro-Magnetic Fire Alarm,	Henry Van Ansdall, .	ib.

RE-ISSUES.

1.	Improvement in Manu'g Bullets, &c.,	George W. Campbell, .	245
2.	—— Making Lamp Black, .	John G. Muir, . .	ib.

DESIGNS.

1.	For a Cooking Stove, . .	Samuel Eberly, .	245
2.	—— Water Cooler, .	Patrick Malony, . .	246
3.	—— Cooking Stove, . .	Russell Wheeler and S. A. Bailey,	ib.
4.	—— Do. do., .	G. Smith, H. Brown, and J. Halzer, ass'd to North, Harrison and Chase,	ib.
5.	—— Grate Frame and Fender .	James L. Jackson, .	ib.
6.	—— Do. do.		
7.	—— Grate Frame, Summer Piece, and Fender, . .		
8.	—— Cooking Stove, .	F. Schultz, ass'd to W. P. Cresson,	ib.
9.	—— Stove, . . .	J. Beesly & E. Delany, ass'd to W. P. Cresson, . .	ib.
10.	—— Cooking Stove, .	J. Beesly, ass'd to R. Peterson,	ib.
11.	—— Parlor Stove, . .	Dutee Arnold, . .	ib.
12.	—— Six Plate Stove, .	S. F. Pratt, ass'd Jaggers, Treadwell & Co.	ib.
13.	—— Cooking Stove, . .	J. S. Perry, do. do. do.	ib.
14.	—— Do. do., .		
15.	—— Parlor Stove, . .	E. Ripley, ass'd to N. S. Vedder, .	247
16.	—— Parlor Stove Plate, .	S. A. House, ass'd to H. House,	ib.
17.	—— Do., Top and Front Plate, .		
18.	—— Do., Front, . .		

September, 1852.

1.	Improvement in Smoothing Irons, .	Fedral C. Adams, . .	247
2.	—— Making Carriage Wheels,	Chauncy H. Guard, .	ib.
3.	—— Refrigerator of Wort, .	Adolph Hammer, . .	ib.
4.	—— Feeding Chickens, .	Simeon W. Albee, .	ib.
5.	—— Railroad Signals, . .	Aurin Bugbee, . .	248
6.	—— Preserving India Rubber,	Frederick Bronner, .	ib.
7.	—— Grain Harvesters, .	Daniel Fitzgerald, . .	ib.
8.	—— Manufacture of Salt, .	James P. Haskin, .	ib.
9.	—— Do. of Sulphuric Acid,	Carl Hiwuchs, . .	ib.
10.	—— Composition of Enamels,	J. G. Dunn and A. F. Howes,	ib.
11.	—— Heating Water for Locomotives, &c,	Israel P. Magoon, . .	ib.
12.	—— Whiffle Tree Hook, .	E. A. Palmer and A. J. Simmons,	249
13.	—— Air-tight Mail Bags, .	C. A. Robbins and H. Allen, .	ib.
14.	—— Dentist's Blow Pipe, .	Julius Thompson, .	ib.
15.	—— Stone Imitation of Marble,	Hiram Tucker, . .	ib.
16.	—— Making Lamp Tops, Rivets, &c.,	Luther C. White, .	ib.
17.	—— Clothes Pins, .	Samuel Aldritch, . .	297
18.	—— Joints for Washing-Machines, &c.,	S. L. Egbert and S. W. Green,	ib.
19.	—— Printing Presses, .	Charles W. Hawks, .	ib.
20.	—— Lightning Rods, . .	Herman H. Homan, .	ib.
21.	—— Smut Machines, .	Charles and James Keeler, .	ib.
22.	—— Making Coiled Wire Ferrules,	William T. Richards, .	298
23.	—— Shuttle Guides to Looms,	Horace T. Robbins, .	ib.
24.	—— Making Porte Monnaies, .	Benjamin S. Stedman, .	ib.
25.	—— Door Locks, . .	W. Moore, ass'd to J. Carman, .	ib.
26.	—— Forging Machines, .	G. H. Richards, ass'd to C. G. Plimpton,	ib.
27.	—— Alarm Time Piece, .	W. H. and R. T. Andrews, .	299
28.	—— Tuning Pegs for Guitars, .	James Ashborn, .	ib.
29.	—— Carving Machines, .	Charles E. Bacon, . .	ib.
30.	—— Coating Iron with Copper, .	Theodore G. Bucklew, .	ib.
31.	—— Hand Drilling Machine,	Reuben Daniels, . .	ib.
32.	—— Horse Collars, . .	J. H. Hall and John Lowrey,	ib.
33.	—— Portable Wardrobes, .	Seth L. Hobert, . .	300

34.	Improvement in Beveling Edges of Metallic Strips,	Robert Knight,	300
35.	—— Rakes,	Amza B. Lewis,	ib.
36.	—— Paper-Cutting Machine,	James E. Mallorey,	ib.
37.	—— Crayon Rubber,	Daniel F. Pond,	ib.
38.	—— Free Joint of Tubes,	R. Prosser, ass'd to T. Prosser,	ib.
39.	—— Galvanic Clock,	M. G. Farmer, ass'd to Seth & C. C. Coffin,	ib.
40.	—— Shoes and Gaiter Boots,	Joseph Brackett,	ib.
41.	—— Saw Gummer,	Hosea A. Elmer,	301
42.	—— Piano Forte Action,	George Howe,	ib.
43.	—— Throstle Spinning Machines,	Charles H. Hunt,	ib.
44.	—— Saw Mills,	Hazard Knowles,	ib.
45.	—— Brick Kilns,	Richard E. Schroeder,	ib.
46.	—— Lathe Machines,	Henry C. Smith,	302
47.	—— Sounding Boards of Piano Fortes,	A. Speer and E. Marx,	ib.
48.	—— Forming Sheet Metal Tubes,	Orson W. Stow,	ib.
49.	—— Registers for Omnibuses,	J. Z. A. Wagner,	ib.
50.	—— Bellows for Reed Instruments,	Isaac T. Packard,	ib.
51.	—— Electro-Magnetic Engine,	John S. Gustin,	303
52.	—— Polishing Leather,	J. M. Poole, ass'd to J. Pusey & J. Scott,	ib.

DESIGNS.

1.	For a Medallion of Gen. Scott,	Peter Stephenson,	303
2.	—— Do. F. Pierce,		
3.	—— Coal Stove,	W. L. Sanderson, ass'd to R. & R. R. Finch,	ib.
4.	—— Cooking Stove,	Samuel D. Vose,	ib.
5.	—— Parlor Stove,	C. Harris and P. W. Zoiner,	ib.
6.	—— Cook Stove,	Samuel D. Vose,	ib.
7.	—— Do.,	N. S. Vedder,	ib.
8.	—— Parlor Stove,	J. J. Dudley, ass'd Johnson, Cox & Fuller,	ib.
9.	—— Camera Stand,	W. W. Allen,	304
10.	—— Wire Fence,	Francis Kilburn,	ib.
11.	—— Cooking Stove,	O. W. Andrews, ass'd to J. Backus and J. P. Barstow	ib.

October, 1852.

1.	Improvement in Grain Separators,	Jacob Berger,	304
2.	—— Vise,	William Butler,	ib.
3.	—— Hand Printing Press,	Charles Foster,	ib.
4.	—— Seed Planters,	D. Haldeman,	ib.
5.	—— Rotary Stove Grates,	Alexander Harrison,	305
6.	—— Seed Planter,	Robert Jackson,	ib.
7.	—— Spark Arrester,	Volney P. and B. Kimbell,	ib.
8.	—— Bee Hives,	Lorenzo L. Longstreth,	ib.
9.	—— Upright Piano Forte,	R. E. Letton,	ib.
10.	—— Wringing Clothes,	Joseph P. Martin,	ib.
11.	—— Puddling Iron,	James McCarty,	306
12.	—— Piano Fortes,	James and John McDonald,	ib.
13.	—— Printing Presses,	John G. Nicolay,	ib.
14.	—— Expanding Window Sashes,	Mighill Mulling,	ib.
15.	—— Milling Machines,	W. H. Robertson,	307
16.	—— Priming Fire Arms,	Christian Sharps,	ib.
17.	—— Window Frames,	Henry Clay Smith,	ib.
18.	—— Time Pieces,	Silas B. Terrey,	ib.
19.	—— Churns,	L. A. Brown and H. Bigelow, ass'd to H. K. W. Welch,	ib.
20.	—— Heating Water for Steam Boilers,	M. W. Baldwin and D. Clark,	370
21.	—— Mill Stones,	Thomas Barnet,	371
22.	—— Gang Ploughs,	Charles Bishop,	ib.
23.	—— Sugar Boiling,	William H. Clement,	ib.
24.	—— Scumming Sugar Pans,	Do. Do.,	ib.
25.	—— Distilling Apparatus,	Charles Delescluze,	ib.
26.	—— Gas Apparatus,	Robert Foulis,	ib.
27.	—— Making India Rubber Bat Cloth,	Charles Goodyear,	372
28.	—— Electro-Magnetic Engines,	John S. Gustin,	ib.

29.	Improvement in Safety Valves,	Alfred Guthrie,	372
30.	—— Double Seaming Machines,	Walter Hamilton,	ib.
31.	—— Homony Mills,	James Hughes,	ib.
32.	—— Presses,	Daniel Kellogg,	ib.
33.	—— Gas Regulators,	Walter Kidder,	ib.
34.	—— Do. do.	Do.,	373
35.	—— Do. do.	Do.,	ib.
36.	—— Harness Saddle Trees,	T. Murdock and W. Kellar,	ib.
37.	—— Transporting on Inclined Planes,	Samuel McElfatrick,	ib.
38.	—— Grinding Mills,	Oldin Nichols,	ib.
39.	—— Window Sashes,	Mighill Nutting,	ib.
40.	—— Plough Fastenings,	James Robb,	ib.
41.	—— Seed Planters,	Do.,	ib.
42.	—— Spirit Gas Lamps,	Rufus W. Sargent.	374
43.	—— Packing Water Wheels,	Erasmus Smith,	ib.
44.	—— Governors,	John Thompson,	ib.
45.	—— Glass Buttons,	Arad W. Welton,	ib.
46.	—— Sewing Machines,	Otis Avery,	ib.
47.	—— Manuring Lands,	Lewis Cooper,	375
48.	—— Cutting Pegs out of Boot Soles,	D. D. Allen,	ib.
49.	—— Grain Separators,	Peter Geiser,	ib.
50.	—— Printing Presses,	Lucius T. Guernsey,	ib.
51.	—— Seed Planters,	Edson Hart,	ib.
52.	—— Discharging Bilge Water,	Nehemiah Hodge,	ib.
53.	—— Water Wheels,	Ira Jagger,	376
54.	—— Making Soda Ash, &c.,	Henry Pemberton,	ib.
55.	—— Bedsteads,	Daniel W. Smead,	ib.
56.	—— Sash Stoppers, &c.,	James D. Smith,	ib.
57.	—— Life Preserver Seat,	George P. Tewksbury,	ib.
58.	—— Burglar Proof Plates for Doors, &c.	Linus Yale, jr.,	ib.
59.	—— Making Crucibles, &c.,	John Akrill,	ib.
60.	—— Boot Crimps,	Leeman Barrett,	377
61.	—— Bitt or Drill Stock,	Dexter H. Chamberlain,	ib.
62.	—— Gilding Daguerreotypes,	Charles L'Hommedeu,	ib.
63.	—— Making Paper Bags,	Francis Wolle,	ib.
64.	—— Combing Wool,	S. C. Sister and G. E. Donisthorpe,	ib.
65.	—— Watch Keys,	Charles E. Jacot,	378
66.	—— Hot Air Furnaces,	A. M. Rice, ass'd to Self & S. H. Lombard,	ib.
67.	—— Cooking Stoves,	H. H. Huntley, ass'd to D. T. Woodrow,	ib.
68.	—— Hot Air Furnaces,	A. Richmond, ass'd to Barstow & Co.,	ib.
69.	—— Locks,	F. G. Coffin,	ib.
70.	—— Constructing Ploughs,	A. Gardner and Est. of W. L. Hunter,	ib.

RE-ISSUES.

1.	Improvements in Seed Planters,	Lewis Moore,	378

DESIGNS.

1.	For a Cooking Stove,	Charles B. Tuttle,	379
2.	—— Grate Frame & Summer Piece,	Adam Hampton,	ib.
3.	—— Table Frames and Legs,	Walker Bryant,	ib.
4.	—— Grate Frame,	James L. Jackson,	ib.
5.	—— Parlor Stove,	N. S. Vedder,	ib.
6.	—— Cooking Stoves,	Elihu Smith,	ib.
7.	—— Forks, Spoons, &c.,	R. Taylor and R. D. Lawrie,	ib.
8.	—— Cooking Range,	B. Wardwell and E. R. Barstow,	ib.
9.	—— Cast Iron Cradle,	P. M. Hutton,	ib.
10.	—— Cooking Stove,	J. Wager, V. Richmond, and H. Smith,	380

November, 1852.

1.	Improvements in Weaving Pile Fabrics,	Erastus B. Bigelow,	380
2.	—— Shoemaker's Edge Planes,	Nicholas Bucher,	ib.
3.	—— Sewing Machine,	Christopher Hodgkins,	ib.
4.	—— Vibrating Propellers,	Franklin Kellsey,	ib.
5.	—— Gas Metres,	John Laidlaw,	ib.
6.	—— Saw Gummer,	J. D. Otstot,	381

7.	Improvements in Wire Ferrules	W. T. Richards,	382
8.	—— Seed Planters,	Charles Randall,	ib.
9.	—— Cooking Stoves,	Manly C. Sadler,	ib.
10.	—— Seed Planters,	Francis Townsend,	ib.
11.	—— do. do.,	Constant S. Trevitt,	ib.
12.	—— do. do.,	Henry Vermillion,	ib.
13.	—— Ventilator,	David Wells,	382
14.	—— Securing Vault and Safe Doors	F. C. Goffin,	ib.
15.	—— Harnesses in Looms,	James Greenhalgh,	ib.
16.	—— Self-Acting Mules,	Wanton Rouse,	ib.
17.	—— Drilling Stone,	L. P. Jenks, ass'd to G. A. Gardner,	383
18.	—— Sewing Machines,	J. G. Braden, ass'd to Self & G. Perkins,	ib.
19.	—— Hand Seed Planters,	William Bullock,	ib.

Accidents—On the Cause and Means of Preventing Railway . 81
Acid and Oxygen—Observations on the Formation of Sulphuric Acid from Sulphurous 111
—— Gas Engine—Description of Lackerstein's Carbonic . . 230
Air Locomotive—Trial of Parsey's Compressed . . 231
— Pump—Method of Obtaining a perfect Vacuum in the Receiver of an . 199
— Vessels in Pumps—On the use of 367
Alkalies—On the Compounds of Cotton with 69
Amazon—Chemical Report on the Cause of the Fire in the . 201
Anthracite and Bituminous Coals, for the purposes of Generating Steam—Report of the Engineer in Chief, of the Navy, on the Comparative Value of . 217
Architect—By S. Sloan—Notice of the Model . . 285
Arctic—On her Eighth Voyage—Performance of the U. S. Mail Steamer . 55
Artesian Wells, &c.—Report on J. Thomson's Improvement in Boring . 425
Artificial Hydraulic or Portland Cement—With an Account of Testing of the Brick Beam erected at the Great Exhibition . 159
——— Stone—Improvements in Manufacture of Glass, Porcelain, Earthenware, China, &c., &c., ... 66
Axles—On the Manufacture of Malleable Iron and Railway . 330

Baillie's Volute Springs—Description of 58
Bakewell (T. W.) on Oblique Action, ... 46

Bibliographical Notices.

Bartlett's Elements of Natural Philosophy, . . . 288
Blatchford's Circuit Court Reports, Vol. 1, ... 287
Industrial Drawing, comprising the Description and Use of Drawing Instruments, &c.,—D. H. Mahan, ... 428
Model Architect, by S. Sloan, ... 285
Binocular Vision—On some remarkable Phenomena of . . 196
Bituminous and Anthracite Coals, for the purpose of Generating Steam—Report of the Engineer in Chief, U. S. N., on the Comparative Value of . 217
Blooming Rolls—Description of Ellis' . . 143
Boats and Ships—Hints on the best Forms of . 47, 130, 177, 271, 309, 414
——, Description of Improved Self-Acting Plugs for . . 359
Boghead Coal—A Fyfe on the Manufacture of Hydro-Carbon Coal Gas from 347, 399
Boring Artesian Wells, &c.—Report on J. Thomson's Improvement in 425
Bronze, Casting in 316

Carbonic Acid Gas Engine—Description of Lackerstein's . . 230
Cast Irons—On the influence of Sulphur on the Nature of . 259
Casting in Bronze, ... 316
Cement—Observations on Artificial Hydraulic or Portland . 159
Charcoal and several other Bodies—On the Discoloring Properties of . 142
Chemical Report on the Cause of the Fire in the Amazon, . 201
Chemistry to Perfumery—Application of Organic . . 60
China and Artificial Stone—Improvements in the Manufacture of Glass, Porcelain, Earthenware, ... 66
Clocks—Prof. Brande on Electro-Magnetic . . 195
Coal Gas from Boghead Coal—A Fyfe on the Manufacture of Hydro-Carbon 347, 399

Coal Mines—Report on the Causes of the frequency of Explosions in . 323
Coals for the purpose of Generating Steam—Report of the Engineer in Chief, U. S. N., on the Comparative Value of Anthracite and Bituminous, . 217
Collins' Steamships—Notice of 114
Cotton as an Element of Industry—Remarks on . . . 213
Cotton or Wool obtained from the leaves of the Pine Tree, . 442
——— with Alkalies—On the Compounds of . . . 69
Crank of a Steam Engine—Diagrams illustrating the Forces on the . 190
Crystals contained in Glass—Note on the . . . 123

Decolorizing Properties of Charcoal and several other Bodies—On the . 142
Density of the Earth—M. Reich on the . . . 424
Diamond, larger than the Regent's, found at Nizam—Account of a . 420
Drawing Instruments, &c.—Notice of Mahan's Industrial Drawing, comprising the Description and Use of 428
Dynamical Effect of Falling Bodies—Haswell (C. H.) Experiments to Determine the 421

Earth—M. Reich on the Density of the . . 424
Earthenware, China and Artificial Stone—Improvement in the Manufacture of Glass, Porcelain, ... 66
Economy of the Steam Engine—Notice of a Disputed Question connected with the 368
Electric Property of Flame—Prof. Buff on the . . 270
Electricity—Faraday's Experimental Researches in . . 66
Electro-Magnetic Clocks—Prof. Brande on . . 195
Engineer Corps of the U. S. Navy—List of the . . 114
Expansion of Isolated Steam and the Total Heat of Steam—On the . 361
———— some Solid Bodies by Heat—On the . . 63
———— Steam Engine—On a Continuous . . 125
Etherification—Observations on . . . 103
Explosion of a Steam Boiler in London—Notice of an . 359
Explosions in Coal Mines—Report on the Causes of the frequency of . 323

Falling Bodies—Haswell (C. H.) Experiments to Determine the Dynamical Effect of 421
Fire Arms—Remarks on Maynard's System of Priming for . 339
—— in the Amazon—Chemical Report on the Cause of the . . 201
Fires—Recipe for Mixtures for Colored . . 206
Fisher's (J. H.) Remarks on Railways and other Roads, . . 154
Flame—Prof. Buff on the Electric Property of . . 270
Flowers—Notice of Iron 215

Franklin Institute.

Proceedings of Monthly Meetings, . . 70, 144, 216, 279, 424

Committee on Science and the Arts.

Report on J. Thomson's Improvement in Boring Artesian Wells, &c., 425

Galvanic Battery—On the flow of Liquids from the Positive to the Negative Pole of a Closed 405
——— Silvering—Note on 138
Gas Engine—Description of Lackerstein's Carbonic Acid . . 230
—— from Wood—On the Manufacture of . . 271
———— Boghead Coal—A Fyfe on the Manufacture of Hydro-Carbon Coal 347, 399
Gilman (S. H.) Remarks on the Steam Boats on the Western Waters, . 207
Glass—Method of obtaining Positive Direct Photographic Impressions upon 395
——, Notes on the Crystals contained in . . 123
——, Porcelain, China, and Artificial Stone—Improvements in the Manufacture of 66
Golden Gate—Notice of the Pacific Mail Steamer . . 119

Haarlem Lake—Account of the Drainage of . . . 295
Hare's (Dr.) remarks on a Report of the Academy of Science of France on Tornados 28
Haswell (C. H.)—Experiments to Determine the Dynamical Effect of Falling Bodies, 421
Heat—On the Expansion of some Solid Bodies by . . 63
Hydraulic or Portland Cement—Observations on Artificial . 159
Hydro-Carbon Coal Gas from Boghead Coal—Fyfe (A.) on the Manufacture of 347, 399

Incrustations in the Boilers of the Steamship Isabel—Remarks on . 233
——————— Steam Boilers—Note on the . . 124
Indian Steel—On the Composition of Wootz or . . 212
Industrial Drawing—Comprising the Description and Use of Drawing Instruments, &c.—Notice of Mahan's . . . 426
Iron and Railway Axles—On the Manufacture of Malleable . 330
——, Description of Ellis's Blooming Rolls for the Manufacture of . 143
—— Flowers—Notice of . . . 215
—— Making Resources of G. Britain, and the First Process in Iron Making—On the 250
—— Masts for Sailing Vessels—On the Construction of . . 337
——, Notice of the Exhibition at the Crystal Palace of Silesian . 205
——, On the Influence of Sulphur on the Nature of Cast . . 259
—— Ship Building 77
—— Steamer Richard Stockton—Notice of the . . 423
——, The Resisting Powers of Cast . . . 3
—— Vessels—The Effects of Shot on . . 73
Isherwood's (B. F.)—Notes on the United States Steamer Walker . 49
——————— ——————— Mail Steamer Arctic . 55
——————— ——————— United States Steam Frigate Mississippi . 384
——————— Remarks on the United States Steam Ship Susquehanna 251
Jeffers' (W. N.) Remarks on the Rifle . . . 145
——————————— Application of Steam to Ships of War 289
——————————— Maynard's System of Priming for Fire Arms . 339

Lake—Account of the Drainage of Haarlem . . . 295
Land from the Sea in the Netherlands—Enclosure of . . 296
Law—Notice of Blatchford's Circuit Court Reports, Vol. 1, . . 287
Liquids from the Positive to the Negative Pole of a Closed Galvanic Battery—On the Flow of 405
Locomotive Power on the Caledonia Railway—Cost of . 6
——————— Trial of Parsey's Compressed Air . . 231
Looms—Infinitesimal Taking-up Motion in Power . . 307
Lucifer Matches—Description of an Improvement in . . 211

Macadam—Notice of the Death of Sir James . . 296
Magnetic Clocks—Prof. Brande on Electro- . . . 195
——————— Force—Faraday on the Lines of . . 108
Magnetizing Steel—New Method of . . . 182
Main Spring of a Watch—A. Young, on the Theory of the . 344
Malleable Iron and Railway Axles—On the Manufacture of . . 330
Marine Boilers—On certain points in the Construction of . 39
——————— Engines—On an Improved Boiler for . . . 116
Masts for Sailing Vessels—On the Construction of Iron . 337
Matches—Description of an Improvement in Lucifer . . 211
Maynard's System of Priming Fire Arms—Remarks on . 339
Metallic Constructions—Fairbairn on . . . 1, 73
Mines—Report on the Causes of the frequency of Explosions in Coal 323
Mississippi—Isherwood, (B. F.) Notice of the U. S. Steam Frigate . 384
Model Architect—Notice of the . . . 285

Natural Philosophy—Notice of Bartlett's Elements of . . 288
Navy—List of the Engineer Corps of the United States . 114
Netherlands—Enclosure of Land from the Sea in the . . 296
Nizam—Account of a Diamond larger than the Regent's, found at . 420

Oblique Action—Bakewell (T. W.) on . . . 46
Ordnance Range and Velocity 295
Oxygen from Melted Silver 396
———, Observations on the Formation of Sulphuric Acid from Sulphurous Acid and 111

Pacific Mail Steamer Golden Gate—Notice of the . . 112
Paddles Combined—J. Bourne on the Screw and . . 317

Patent Law—Report.

Woodworth's Planing Machine Case . . . 23

Pearly Lustre to Stone, Glass, &c.—Process for giving a . 338
Perfumery—Application of Organic Chemistry to . . 60
Photographic Impressions on Glass—Method of Obtaining Positive Direct 395
———— Paper—Description of a New Method of Preparing Negative . 65
Photographs—Notices of Engraved . . . 121
Pine Tree—Cotton or Wool Obtained from the Leaves of the . . 412
Plugs for Boats—Description of Improved Self-Acting . . 359
Population within certain limits in the United States—Estimate of the Density of the 71
Porcelain, Earthenware, China, and Artificial Stone—Improvements in the Manufacture of Glass, ... 66
Portland Cement—Observations on Artificial, Hydraulic, or . . 159
Power Looms—Infinitesimal taking-up Motion for . . 307
Priming for Fire Arms—Jeffers' (W. N.) Remarks on Maynard's System of 339
Propeller Steamers between Boston and Halifax—Notice of . . 57
Pumps—On the Use of Air Vessels in . . . 367

Railroads in the United States—Smith's (G. W.) Estimate of the Number of Miles that will be Completed at the end of 1852 . . 70
Railway Accidents—On the Cause, and Means of Preventing . . 81
——— Axles—On the Manufacture of Malleable Iron, &c. . 330
———, Cost of Locomotive Power on the Caledonian . . 6
Railways as a Means of Transit—Economy of . . 5
——— and other Roads—Fisher's (J. H.) Remarks on . . 154
——— in Great Britain—Law Expenses of . . 228
———, Speed and Fares on the Great Western and London, and North Western 232
Richard Stockton—Notice of the Iron Steamer . . 423
Rifle—Jeffers' (W. N.) Remarks on the . . 145

Sailing Vessels—Note on the Construction of Iron Masts for . . 337
Screw and Paddle Combined—Bourne (J.) on the . . 317
Sea in the Netherlands—Enclosure of Land from the . . 296
Ships and Boats—Hints on the best Form for 47, 130, 117, 271, 309, 414
—— Bottom whilst Afloat—Repairs of a . . . 68
Silesian Iron—Notice of the Exhibition at the Crystal Palace, of . 205
Silver—On Obtaining Oxygen from Melted . . . 396
Silvering—Note on Galvanic . . . 138
Spring of a Watch—Young (A.) on the Theory of the Main . . 344
Springs—Description of Baillie's Volute . . 58
Steam Boat Accidents—Loss of the Henry Clay, the Atlantic, and the Reindeer, 267
—— Boats on the Western Waters—Gilman's (S. H.) Remarks on the . 207
—— Boiler Explosion in London—Notice of a . . 359
———— for Marine Engines—On an Improved . . 116
—— Boilers—Gallaway's Improvement in . . 106
————, Notes on the Incrustations in . . . 124
———— of the Steamship Isabel—Remarks on the Incrustations in the 233
———— ————, On certain points in the Construction of Marine . 39
—— Engine—Diagrams Illustrating the Forces on the Crank of a . 190
————, On a Continuous Expansion . . 125
————, Notice of a Disputed Question connected with the Economy of the 368
—— Frigate Mississippi—Isherwood's (B. F.) Notes on the United States 384
—— Generator—Description of a Diaphragm . . 39
——, On the Expansion of Isolated Steam, and the Total Heat of . 361
——, ——Colors of a Jet of . . . 336
——, Report of the Engineer-in-Chief, United States Navy, on the Comparative Value of Anthracite and Bituminous Coals for Generating . 217
—— Ship Susquehanna—Isherwood's (B. F.) Remarks on the United States 251
—— Ships—Notice of Collins' Line of . . . 114
—— to Ships of War—Remarks on the Application of . 280
Steamer Arctic—Notice of Performance on her Eighth Voyage . 55
——— Golden Gate—Notice of the Pacific Mail . . 122
——— Richard Stockton—Notice of the Iron . . 423
——— Walker—Notice on the United States Surveying . . 49
Steamers between Boston and Halifax—Notice of Propeller . 57

Steel—New Method of Magnetizing . . . 182
——, On the Composition of Wootz or Indian . . 212
Stereoscope—Notice of Sir D. Brewster's Lenticular . . 72
Sugar—Gwinne's Improvement in the Manufacture of . . 353
——, Remarks on Bessemer's Process for Manufacturing . . 407
Sulphur upon the Nature of Cast Iron—On the Influence of . 259
Sulphuric Acid from Sulphurous Acid and Oxygen—On the Formation of . 111

Telegraphic Lines of the World, by Dr. L. Turnbull—On the . 40, 133, 183, 256
Telescope at Wandsworth Common—Description of the Gigantic . 397
Temperatures—On a New Method of Measuring High . 277
Thomson (J.) Improvement in Boring Artesian Wells, &c.—Report on . 425
Tornados—Dr. Hare's Remarks on a Report to the Academy of Science of France, on 28

Vacuum in the Receiver of an Air Pump—Method of Obtaining a Perfect . 199
Ventilating Wind Guard—Description of a . . . 396
Vessel's Bottom whilst Afloat—Repairs to a . . . 68
Vessels—On the Construction of Iron Masts for . . 337
——, ——Effect of Shot on Iron . . . 73
Vision—On some Remarkable Phenomena in Binocular . 196
Volute Springs—Description of Baillie's . . . 58
Voltaic Couple—A New Arrangement of the . . 141

Walker—Notes on the United States Surveying Steamer . . 49
Watch—Young (A.) on the Theory of the Main-Spring of the . 344
Wells, &c.—Report on J. Thomson's Improvement in Boring Artesian 425
Western Waters—Gilman's (S. H.) on the Steam Boats on the . 207
Wind Guard—Description of a Ventilating . . 396
Wood—On the Manufacture of Gas from . . . 271
Woodworth's Planing Machine Case—Law Report of . . 23
Wool or Cotton obtained from the Leaves of the Pine Tree . . 412
Wootz or Indian Steel—On the Composition of . . 212

Young (A.) on the Theory of the Main-Spring of the Watch . . 344